COMPARISON OF THE EFFECTS OF SELF LIGATING VERSUS CONVENTIONAL MC LAUGHLIN, BENNETT AND TREVISI BRACKETS IN THE CORRECTION OF LOWER ANTERIOR CROWDING IN PERIODONTALLY ACCELERATED OSTEOGENIC ORTHODONTICS - A PROSPECTIVE STUDY

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BRANCH – V

ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS

THE TAMILNADU DR. M.G.R MEDICAL UNIVERSITY

CHENNAI – 600 032

2015 – 2018

CERTIFICATE

This is to certify that **Dr.M.MANGALESWARI,** Postgraduate student (2015-2018), in the Department of Orthodontics and Dentofacial Orthopedics (branch V), Tamil Nadu Government Dental College and Hospital, Chennai-600 003, has done this dissertation titled **"Comparison of the effects of self ligating versus conventional Mc Laughlin, Bennett and Trevisi brackets in the correction of lower anterior crowding in Periodontally Accelerated Osteogenic Orthodontics - A prospective study"** under my direct guidance and supervision for partial fulfilment of the M.D.S. degree examination in May 2018 as per the regulations laid down by The **Tamil Nadu Dr. MGR Medical University,Chennai-600032** for **M.D.S Orthodontics and Dentofacial Orthopaedics (branch V)**degree examination.

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DECLARATION

I, **Dr. M.MANGALESWARI**, do hereby declare that the dissertation titled **"Comparison of the effects of self ligating versus conventional Mc Laughlin, Bennett and Trevisi brackets in the correction of lower anterior crowding in Periodontally Accelerated Osteogenic Orthodontics - A prospective study"** was done in the Department of Orthodontics, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government Dental College for the study in partial fulfilment of the requirements for the degree of Master of Dental Surgery in the specialty of Orthodontics and Dentofacial Orthopaedics (Branch V) during the course period **2015-2018** under the conceptualization and guidance of my dissertation guide, **Professor Dr. SRIDHAR PREMKUMAR, M.D.S.**

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from The Tamil Nadu Government Dental College & Hospital.

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I thank **my family especially my father, mother, son, husband, father in-law, mother in law and sisters** for their unconditional love and affection and constant support. Without them, nothing would have been made possible.

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TRIPARTITE AGREEMENT

This agreement herein after the "Agreement" is entered into on this..... day of January 2018 between the Tamil Nadu Government Dental College and Hospital represented by its **Principal** having address at Tamil Nadu Government Dental College and Hospital, Chennai-03, (hereafter referred to as, " the college")

And

Dr. SRIDHAR PREMKUMAR aged 50 years working as professor at the college, having residence address B-3, Block 2, Jains Ashraya Phase III, Arcot road, Virugambakkam, Chennai-92. (Herein after referred to as the 'co-investigator)

And

Dr. MANGALESWARI.M aged 33 years currently studying as postgraduate student in department of Orthodontics in Tamil Nadu Government Dental College and Hospital (Herein after referred to as the "PG/Research student and Principal investigator").

Whereas the, PG/Research student as part of his curriculum undertakes to research ***"Comparison of the effects of self ligating versus conventional Mc Laughlin, Bennett and Trevisi brackets in the correction of lower anterior crowding in Periodontally Accelerated Osteogenic Orthodontics-a prospective study"*** for which purpose the co-investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Principal investigator.

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Witnesses **Student Guide**

1.
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Ref No: R. C. NO: 0420/DE/2016 date : 01-08-2016
Sub: IEC review of the research proposals,

Title of the work: Comparison of the effects of self ligating vs conventional Mc Laughlin ,Bennett and Trevisi brackets in the correction of lower anterior crowding in Periodontally Accelerated Osteogenic Orthodontics -A prospective study

Principal Investigator: Dr.M.Mangaleswari
II yr PG student.

Department : Department of Orthodontics and Dentofacial Orthopaedics,
Tamil Nadu Govt. Dental College & Hospital , Chennai-3

Thank you for submitting your research proposal , which was considered at the Institutional Ethics Committee meeting held on the 01.07. 2016, at TN Govt. Dental College and the documents related to the study referred above were discussed and the modifications done as suggested and reported to us through your letter dated 30 - 07 -2016 have been reviewed. The decision of the members of the committee , the secretary and the Chairperson IEC of TN Govt. Dental College is here under:

Approved	Approved and advised to proceed with the study
Approved with suggestions	----------
Revision	----------

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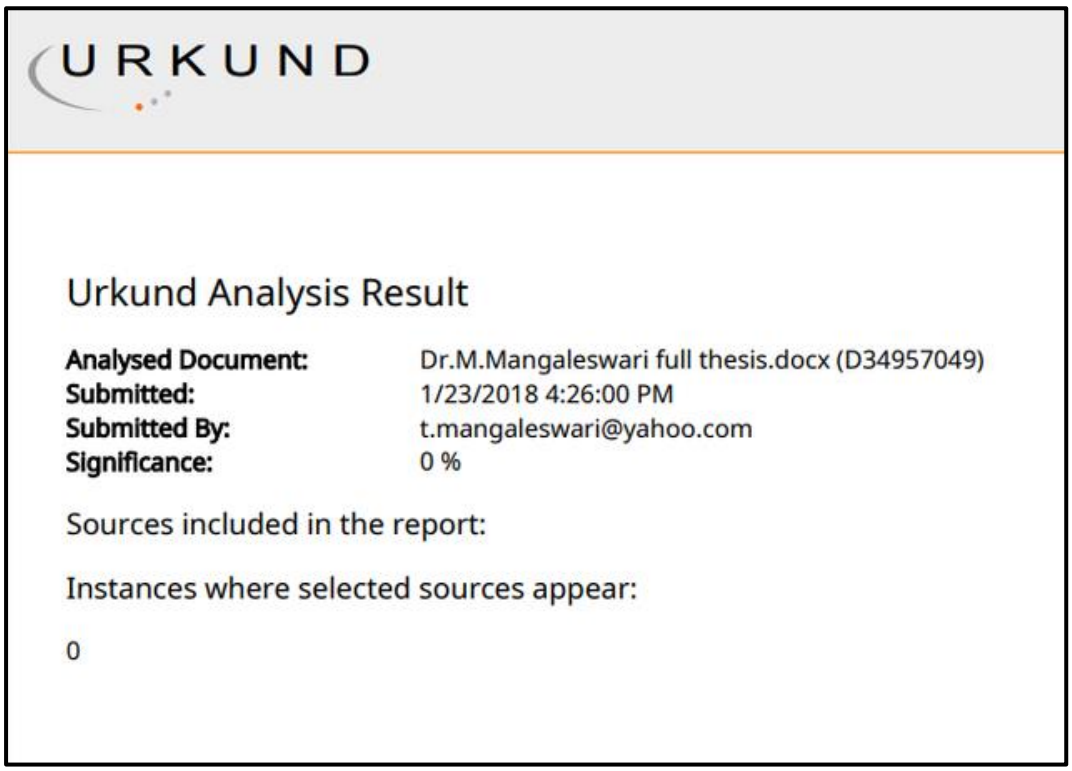

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1.	MBT-Mc-Laughlin,Bennett and Trevisi
2.	PAOO-Periodontally Accelerated Osteogenic Orthodontics
3.	L1-MP-Lower incisor to Mandibular plane
4.	L1-A-POG-Lower incisor to A point Pogonion
5.	L1-NB-Lower incisor to Nasion B point
6.	SPSS-Statistical Package for Social Sciences
7.	deg-degree
8.	mm-millimetre
9.	ss-stainless steel
10.	niti-nickel titanium
11.	OPG-OrthoPantomoGraph

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1. Participant Information sheet (English)

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INTRODUCTION

Necessity is the mother of invention. The increased demand for reduced treatment time in the current busy mechanical life of people has led the orthodontists to focus and to research more on accelerating the orthodontic tooth movement[1,2].Conventional orthodontic treatment requires almost 2-3 years to complete[2] which most of the orthodontic patients particularly youngsters do not like and they want treatment to finish within 6 months[1.]Extensive research in this field has led to various methods to accelerate orthodontic tooth movement by physical, mechanical, pharmacological and biological ways[3]. The methods include physical stimuli such as light[4], electric current[5], static magnetic field[6,7],pulsed electromagnetic field [8], low level laser therapy[9,10] and mechanical stimuli such as vibration[11.] Hormones such as parathyroid hormone[12], vitamin D_3[13, 14], corticosteroids[14], osteocalcin[15] and thyroxin[14,] have shown to increase rate of tooth movement. Corticotomies[16-28], piezocision[29, 30], distraction of periodontal ligament [31, 32, 33] and micro-osteoperforations[34] induce rapid orthodontic tooth movement by biological methods i.e. remodeling of tissues surrounding the roots.[27]

Evolution of periodontally accelerated osteogenic orthodontics (PAOO or Wilckodontics) promises to speed up rate of tooth movement and has created a new era in Orthodontics. Periodontally Accelerated Osteogenic Orthodontic tooth movement can significantly reduce treatment duration and the associated risks of prolonged treatment time like root resorption because of low density, decreased treatment duration, decreased post treatment bone loss, high stability leading to less relapse.[26]

Periodontally Accelerated Osteogenic Orthodontic tooth movement suggested by Wilcko brothers combines selective alveolar corticotomy, particulate bone grafting in areas which have undergone corticotomy and the application of orthodontic tooth movement forces. Wilcko (Dr. Thomas Wilcko and Dr. William Wilcko) et al[24,25,35] by their histological and Computer Tomographic studies proved that accelerated orthodontic tooth movement after corticotomy is due to "Regional Acceleratory Phenomenon" which is nothing but increased bone remodeling activity[24,25,35].Thus Wilcko et al[24,25,35] made a conceptual change in the field of accelerated orthodontics and paved way for further development in this field.

Self ligation bracket[36] especially passive self ligating brackets have been proved to have greater efficiency in initial alignment and leveling phase. This is attributed to low friction due to passive engagement of the arch wire within the bracket slot. The clinical significance of low friction includes rapid tooth movement because of decreased frictional resistance, less anchorage demand, posterior arch expansion and less relapse. This study is aimed to find out the synergistic effect of self ligating brackets along with periodontally accelerated osteogenic orthodontics. This study is an attempt to study the beneficial effects of combining the two major philosophies of orthodontics namely periodontally accelerated osteogenic orthodontics and self ligation bracket system**.**

AIM AND OBJECTIVES

AIM OF THE STUDY

The aim of this prospective study is to find any synergistic effect of self ligation brackets in periodontally accelerated osteogenic orthodontics with respect to treatment duration of alignment and leveling of mandibular arch with crowding.

OBJECTIVES OF THE STUDY

- To assess the treatment duration of alignment and leveling of mandibular arch with self ligation MBT (Mc Laughlin, Bennett and Trevisi) bracket system in periodontally accelerated osteogenic orthodontics in days.
- To assess the treatment duration of alignment and leveling of mandibular arch with conventional elastomeric MBT bracket system in periodontally accelerated osteogenic orthodontics in days.
- To compare the treatment duration of alignment and leveling of mandibular arch in self ligation MBT bracket system with conventional elastomeric MBT bracket system in periodontally accelerated osteogenic orthodontics in days.
- To find any synergism of self ligation MBT bracket system combined with periodontally accelerated osteogenic orthodontics over conventional MBT bracket system routinely used in periodontally accelerated osteogenic orthodontics with respect to treatment duration of alignment and leveling of mandibular arch.

- To assess and compare mandibular incisor inclination changes induced by alignment and leveling phase in self ligating MBT bracket system and conventional elastomeric ligation MBT groups.
- To assess and compare the root resorption of mandibular anterior teeth after alignment and leveling phase in self ligating MBT and conventional elastomeric ligation MBT groups.
- To compare post treatment mesiodistal angulations of mandibular anterior teeth in both self ligating MBT and conventional elastomeric ligation MBT groups to Indian norms after alignment and leveling phase.

REVIEW OF LITERATURE

PERIODONTALLY ACCELERATED OSTEOGENIC ORTHODONTICS

Bichlmayr (1931)[21] used the word minor orthognathic surgery for corticotomy and he used it for closing midline diastema between upper incisors.

Kole et al (1959)[17] first gave the concept of corticotomy facilitated orthodontics to accelerate the treatment duration. The vertical corticotomy cuts extended through the cortex and the horizontal cuts connecting the vertical cuts helped in the "bony block "movement.

Duker (1975)[37] reported that the vascularity of the pulp and the periodontium is not affected by corticotomy and suggested not to involve 2mm of apex of the alveolar crest to preserve the marginal gingiva.

Frost et al (1983)[38] found a direct correlation between amount of trauma and intensity of healing response for which he coined the term Regional Acceleratory Phenomena (RAP). They have stated that it begins some days after the trauma, peaks at 1 to 2 months, and subsides after 6 months to 2 years.

Gantes, Anholm, Rathbun (1990)[22] reported a 14.8 months treatment duration with corticotomy when compared to 28.3 months in conventional orthodontic control group in their series of 5 case reports. The periodontal statuses of these 5 patients were healthy.

Yaffe et al (1994)[39] reported that regional acceleratory phenomenon is seen just after reflection of mucoperiosteal flap in experiment conducted in lower mandible of 120 rats .The bone loss occurred at the maximum in 3 weeks which

can be extrapolated to 3 months in human. Complete repair can be observed after 120 days from surgery. This is the reason for tooth mobility after surgery.

Wilcko et al (2001)[24] showed case reports of moderate dental arch crowding which were completed in 4 to 6 months treated with corticotomy and alveolar bone grafting. They have evaluated the cases before and after the studies with computer tomogram[12]. They coined the term 'periodontally accelerated osteogenic orthodontics', also known as Wilckodontics. They modified existing corticotomies and it involved a combination of full flap elevation both labially and lingually, selective decortication followed by bone grafting along with application of orthodontic forces once in two weeks. They claimed that the rate of tooth movement increases because of "Regional Acceleratory Phenomenon" that is temporary demineralisation and remineralisation of bone (osteopenia) resulting from increased bone turnover and decreased bone density. They stated that the use of alveolar grafting results in stability of orthodontic treatment, facilitate a greater range of tooth movement and create healthy buccal and lingual plates of bone by repairing existing fenestrations and dehiscences.

Twaddle, D.J. Ferguson, W.M. Wilcko (2002)[40] found increased bone density in corticotomy treated subjects compared to non corticotomy treated patients.

Nazarov, Ferguson, Wilcko et al (2004)[41] found improved retention and stability in corticotomy treated subjects than conventional ones.

Skountrianos, Ferguson, Wilcko et al (2004)[42] found corticotomy facilitated orthodontic treatment to be 66% faster and stable in upper arch crowding treatment than non corticotomy cases treated without extraction.

Pham-Nguyen et al (2006)[43] using Micro-CT technology studied the volume of periodontal tissues surrounding the upper first molar in rats, following buccal and lingual selective decortication with tooth movement. They found a significant decrease in alveolar mineralization became evident by 7 days after decortication, and the tooth movement prolonged the osteopenic effect induced by the selective decortication

Ferguson DJ and Wilcko et al (2006)[44] suggested new envelope of discrepancy following selective alveolar decortication for orthodontic tooth movement for adult.

Fischer et al (2007)[45] showed that the rate of tooth movement was increased by 28-30 % for exposure of bilaterally impacted canines assisted by corticotomy. They reported that the rate of tooth movement was significantly higher in the corticotomy group than the conventional group.

Ren et al (2007)[46] found less root resorption in corticotomy than the conventional treatment in beagles dogs. They attributed the reason to lesser hyalinisation periods in corticotomy.

Wilcko et al (2008)[25] showed 300% to 400% faster orthodontic tooth movement and reduction of treatment time to 1/3 rd to 1/4 th of the conventional treatment time in their case reports. It increased the envelope of movement to 2 to 3 fold by alveolar augmentation.

Lee et al (2008)[47] showed that corticotomy facilitated orthodontics reduces treatment duration in bimaxillary protrusion cases by 2 to 2.5 times

Wang and Lee (2009)[48] studied histology and immunostaining in rats comparing phases of tooth movement in corticotomy and osteotomy. The three phases of bone healing in corticotomy combined with tooth movement group are a resorptive phase on day 3 (more osteoclasts), a replacement phase on day 21 (more osteoblast-like cells), and a mineralization phase on day 60 (non-lamellar bone formation) in the compression site.

Aboul-Ela et al (2011) [49]showed that the rate of miniscrew assisted canine retraction was significantly larger in the corticotomy group than the conventional group. They have shown that the corticotomy assisted tooth movement peaks at 1 or 2 months, then decreases and reaches normal values after 4 months. Augmentation grafting results in greater range of tooth movement due to increased alveolar volume and helps in repair of existing fenestration and dehiscence. Corticotomy facilitated orthodontics is 1.5 to 2 times and Piezocision is 1.5 times faster than conventional orthodontics.

Peter H. Buschang, Phillip M. Campbell, and Stephen Ruso (2012)[50] described the advantages of accelerated orthodontics including reduced side effects of prolonged treatment duration including root resorption, decalcification of enamel, gingival enlargement and dental caries (banded teeth). This review article shows that the effects of corticotomies are limited to 2 to 3 months in which 4 -6 mm of tooth movement occurs.

Jorge Cano et al (2012)[51] in their systematic review explained about the important persons in the evolution of orthodontics. In 1972 Bell and Levy performed interdental vertical osteotomy cuts in 49 monkeys involving both cortex and medulla.

Shoreiba EA et al (2012)[52] conducted a randomised control trial to find the differences in treatment time and clinical periodontal parameters in correction of moderate crowding between corticotomy facilitated orthodontics and conventional orthodontics. The treatment timing and root resorption were reduced in the corticotomy group. No differences in clinical probing depth and net percentage of bone density were observed between groups.

Shoreiba EA et al (2012)[53] conducted a randomised control trial to find difference between clinical periodontal parameters and bone density between patients with corticotomy alone and corticotomy with grafting in alleviation of lower anterior crowding .The study revealed graft has no role in increasing rate of tooth movement. There was difference in clinical periodontal parameters and root resorption between the groups. Group I had more reduction in bone density.

Bhattacharya et al (2014)[54] conducted a randomised control trial with sample size of 30 to find changes in alveolar bone thickness with computer tomographic images at 3 points of time in corticotomy group. They found a significant increase in alveolar bone thickness in the corticotomy group. The rate of space closure was 4.35 months in the corticotomy group and compared to 7.8 months in the control group.

Hoogeveen, Jansma and Ren (2014)[27]conducted a systematic review to evaluate the effectiveness of corticotomy and dental distraction in reducing treatment duration and complications. All publications supported reduction of treatment time with no side effects of surgery including deleterious effects on the periodontium, vitality loss, and severe root resorption. Insufficient evidence is available for treatment stability with corticotomy.

Huang, Williams and Kyrkanides (2014)[26] reviewed literature and their article gives a bird's eye view into the molecular mechanisms behind the accelerated tooth movement. This article also insists that the rate of tooth movement is determined mainly by accelerating the rate of remodelling of tissues in periodontium .This is by means of demineralisation of bone by osteoclasts and remineralisation by osteoblasts. Osteoblasts accelerate the rate of tooth movement indirectly by stimulating the formation of osteoclasts. Osteoblasts help in maintaining bone density. Thus the bone cells including osteocyte, osteoclasts and osteoblasts determine the rate of tooth movement which is under control of mechanical and chemical factors including prostaglandins and cytokines.

Alansari *et al* (2015)[3] explained the biology of accelerated tooth movement in their article. The rate of tooth movement is increased by recruitment and activation of osteoclasts which in turn is controlled by cytokines. Amount of trauma influences rate of tooth movement whereas shape of trauma has no role. Bone grafts have no role in increasing rate of tooth movement but increase the range of tooth movement in cortical bone.

Makki *et al* (2015)[55] evaluated mandibular irregularity index in corticotomy treated and conventionally treated orthodontic patients after 5 and 10 years and found that corticotomy treated patients showed less irregularity index. This shows that the stability of treatment results in periodontally accelerated osteogenic orthodontics

Ali H Hassan et al (2015)[56] reviewed literature and found corticotomy facilitated orthodontics reduces treatment duration by 2 to 2.5 folds. They suggested a 4 to 6 months window period during which rate of tooth movement is

increased after which it is normal. There is no risk of root resorption or no periodontal damage.

Fernández-Ferrer et al (2016)[57] conducted a systematic review to find the efficiency of corticotomy in reducing the treatment duration and arrived at a conclusion that corticotomy significantly reduces treatment time with no periodontal damage

Abbas, Sabet and Hassan (2016)[58] evaluated rate of canine retraction with corticotomy facilitated orthodontics and piezocision. They found corticotomy facilitated orthodontics was 1.5 to 2 times faster than conventional orthodontics whereas piezocision facilitate orthodontics was 1.5 times faster than conventional orthodontics. Conventional corticotomy produced a higher rate of canine retraction than piezocision.

Patterson BM et al (2016)[59] conducted a systematic review and found corticotomy procedures can produce statistically and clinically meaningful temporary increase in the rate of orthodontic tooth movement with minimal side-effects.

Verna C et al (2017)[60] conducted a finite element study. The magnitude of tooth movement is increased in corticotomy because of low bone density. The centre of rotation shifts apically in translational, controlled tipping and uncontrolled tipping in corticotomy**.** Corticotomy simulations show more tensile stresses than compressive stresses.

COMPARISON OF SELF LIGATING AND CONVENTIONAL ELASTOMERIC BRACKETS

Stolzenburg (1935)[61] described the first self ligating bracket Russell Lock edgewise attachment in his article.

Wildman AJ (1972)[62] introduced Edge lock self ligating bracket which is the first self ligating bracket to be produced in bulk quantities

Hanson GH (1980)[63] introduced the Speed bracket.

Harradine (1996)[64] described the clinical uses of Activa bracket

Damon (1998)[65] introduced the Damon self ligating bracket. The Damon philosophy states that light forces cause more physiologic tooth movement without interrupting blood supply. Teeth align by moving through least path of resistance. Orbicularis oris and the mentalis muscle act as lip bumper and reduce the proclination of incisors. Therefore, more alveolar bone generation, lateral expansion of arch, less proclination of anterior teeth because of lip bumper effect, and less need for extractions due to increase in arch length and width are claimed to be possible with self-ligating brackets.

Harradine NW et al (2001)[66] compared Damon self ligation bracket system and conventional elastomeric ligation bracket system in terms of treatment duration .He found 4 months shorter treatment time with self ligation group than the conventional elastomeric ligation group.

Macchi et al (2002)[67] described about the Philippe self-ligating lingual brackets for the first time.

Khambay et al (2004)[68] found less frictional resistance with passive self ligating brackets and unligated brackets.

Miles et al (2005)[69] conducted a retrospective cohort study to find the alignment efficiency between self ligation smart clip and conventional bracket design victory series and arrived at a conclusion that there is no difference between both the bracket systems.

Miles et al (2006)[70] conducted a retrospective cohort study to find the alignment efficiency between 58 patients with Damon 2 brackets and 58 patients with conventional victory series and found no difference.

Miles et al (2007)[71] compared the rate of space closure by individual canine retraction between passive self ligating 3m smart clip brackets and conventional MBT brackets(14 patients each group ,split mouth design study) ligated using stainless steel ligatures and found no difference .

Pandis, Polychronopoulou and Eliades (2007)[36] conducted a prospective clinical trial to compare the treatment duration and dental effects of Damon 2 self ligating and conventional MBT brackets. They found rapid crowding correction in moderate crowding cases with self ligating brackets. Self ligation group showed statistically significant increase in intermolar width, but no difference with respect to intercanine width. Both groups showed proclination of lower anteriors but no statistically significant difference between the groups.

Scott et al (2008)[72] conducted a multicentered randomised control trial to investigate the alignment efficiency in extraction cases with self ligating and conventional MBT brackets. An increase in intercanine width, a reduction in arch

length, and proclination of the mandibular incisors were observed for both appliances, but the differences were not significant. Incisor root resorption was not clinically significant and did not differ between bracket systems.

Trevisi (2008)[73] described the smart clip self ligating appliance features that it contains wire retaining nitinol clips with features of conventional twin brackets. It is a passive self ligating appliance system with MBT prescription.

Fleming, DiBiase and Lee (2009)[74] did a prospective randomised clinical trial to find out treatment efficiency with respect to duration between smart clip self ligating bracket and victory series conventional MBT bracket and found no difference.

Fleming and Johal (2010)[75] conducted multicentre, 3-group parallel randomized trial to compare upper arch dimensional and inclination changes during alignment with conventional brackets ,passive and active self-ligation brackets in 96 patients. No difference in dimensional changes and inclination changes were found.

Vajaria et al (2011)[76] conducted a clinical trial to evaluate the lower incisor position and transverse dimensional changes between self ligation Damon group and standard edgewise bracket. Intercanine width, interpremolar width and intermolar width increased in Damon group with proclination of lower incisors. Post treatment inclination of lower incisors did not differ significantly. Crowding was corrected by both expansion and incisor proclination in both bracket systems.

Mezomo (2011)[77] conducted a prospective clinical trial with split mouth study design in 15 patients to evaluate the anchorage loss and rate of space closure

with individual canine retraction. They used Smart clip and Gemini brackets and found no difference. Rotational tendency of upper canines was minimised in self ligation group.

Kaklamanos, Chen and Athanasiou (2011)[78] conducted a meta-analysis and arrived at a conclusion that there is insufficient evidence for the faster treatment time of self ligation bracket compared to conventional brackets except for shorter appointment timing and incisor proclination.

Wahab et al (2012)[79] conducted a prospective randomised control trial in 29 subjects to find the efficiency of alignment between self ligation and conventional bracket. They found faster alignment with conventional bracket group in the first month and no differences were found in the subsequent 3months. After 4 months, 98 percent crowding alleviation was observed in conventional group whereas 67 percent alleviation of crowding in self ligation group.

Johansson and Lundstrom (2012)[80] conducted a randomised prospective clinical trial in 44 patients with Time self ligation bracket and in 46 patients with 3m Gemini bracket to evaluate the efficiency of Time self ligation bracket. There were no statistically significant differences between the groups in terms of mean treatment time in months and mean number of visits.

Machibya et al (2013)[81] conducted a retrospective cohort study and compared 34 smart clip patient records and 35 victory bracket patient records. No difference was found between the groups with respect to the treatment time, percentage PAR reduction and anchorage. Significant dental and skeletal changes were present in both brackets used. There is more lingual inclination of mandibular incisors in the conventional elastomeric group than in the self ligation group.

Cattaneo, Salih and Melsen (2013)[82] conducted a prospective clinical trial to compare labiolingual root position of lower anterior teeth in 26 patients of passive self ligation group and 20 patients of active self ligation group. Lower incisors proclined by 3.9 degrees in passive self ligation group compared to 3.2 deg in active self ligation group which is against "lip bumper effect "of Damon Philosophy.

Pejda et al (2013)[83] conducted a study to evaluate the difference in periodontal pathogens and clinical parameters between self ligation and conventional MBT. Periodontal status was evaluated using full mouth plaque score, full mouth bleeding score and periodontal pocket depth .Periodontal pathogens were assessed using polymerase chain reaction. Except for increase in Actinobaceter actinomycetemcomitans in conventional bracket design no difference could be found.

Megha Anand et al (2015)[84] conducted a retrospective cohort study from 2 clinicians to assess differences between self ligation and conventional bracket group with respect to treatment time, transverse dimension, arch length, lower incisor inclination, Peer Assessment Score, number of visits and number of emergencies. Though clinician 1 can find significant difference with respect to reduced treatment time in self ligation group, clinician 2 did not find any difference. They concluded that there is no difference between groups.

O'Dywer et al (2015)[85] performed a multicentered prospective clinical trial in three hospitals and 138 subjects and arrived at a conclusion that there is no difference between smart clip self ligating and conventional victory series kit with respect to number of visits and treatment duration. The mean treatment time and

number of visits were 25.12 months and 19.97 visits in the self ligating group and 25.80 months and 20.37 visits in the conventional group.

Rahman et al (2016)[86] conducted a prospective multicentered randomised clinical trial in three hospitals and 138 subjects to find out difference in pain perception between self ligation and conventional MBT bracket system. The investigators found no difference among the groups.

RATIONALE FOR THE CURRENT STUDY

ANIMAL STUDIES FOR ACCELERATED ORTHODONTICS

Ilino et al (2007)[87] found twice the increase in rate of tooth movement in corticotomy side than the conventional side. They have showed lesser root resorption in corticotomy side with appearance of Tartrate Resistant Acid Phosphatase (marker of osteoclast) in histological sections. They have shown that hyalinised zones usually appear before root resorption. They observed hyalinised zones lesser in corticotomy sides.

Baloul et al (2011)[88] studied the morphological, structural and molecular changes underlying selective alveolar decortication in 114 rats using micro CT, Foxitron analysis and qPCR. Corticotomy group showed a steady increase in rate of tooth movement till 21 days with peak at 7days. Conventional group showed a steady increase only after 7 days. It showed an initial tooth movement phase from 7 to 14 days followed by lag phase from 14 to 28 days. There is no difference between 28 to 42 days. Combined selective alveolar decortication with tooth movement group showed a decrease in bone volume and bone mineral content compared to baseline at 7 days whereas it was increased in anabolic phase than the

levels beyond the baseline. These changes were significantly exaggerated and appeared earlier than conventional tooth movement group.

LABORATORY STUDIES FOR EFFICIENCY OF SELF LIGATING BRACKET SYSTEM

Henao and Kusy (2004)[89] studied frictional characteristics of 4 self ligation (Damon 2, In-Ovation, SPEED, and Time) and 4 conventional elastomeric ligation (respective conventional elastomeric MBT bracket types) in typodonts. They found less friction with self ligation group.

Bacetti et al (2009)[90] conducted a laboratory study to analyse the forces produced by four passive self ligation brackets and two elastomeric ligation brackets. They used impacted canine model to find the effective force delivered for alignment of apically displaced canine. It is a known fact that resistance to tooth movement at the bracket, wire and ligature unit represents a combination of friction produced by the ligation method, by the binding of arch wire in bracket, and by wire notching. Till 1.5mm of displacement there was no difference between the brackets. When the displacement increases more than 3mm the forces released by elastomeric ligation decreased gradually and decreased to zero at a time. Though the forces produced in the passive self ligation system decreased, it produced a significantly higher effective force than the elastomeric ligation brackets because of less friction.

Ehsani S et al (2009)[91] did a literature review to find the in vitro studies which compared frictional resistance between self ligation and conventional brackets. Self ligation brackets produced lower friction than the conventional

brackets in smaller round wires in the absence of malocclusion whereas insufficient evidence exist in the presence of malocclusion.

Petersen et al (2009)[92] found self-ligating brackets and used elastomers have greater aligning capacity with less friction when compared with unused elastomers which have more friction.

Iosif Sifakakis, Nikolaos Pandis et al (2010)[93] conducted a laboratory study and found less intrusive forces and increased labio palatal moments of teeth with self ligation brackets.

Brauchli, Senn and Wichelhaus (2011)[94] conducted an experiment to compare the frictional resistance of active, passive and conventional elastomeric ligation with and without tipping moments and in different arch wire combinations. Without tipping moment passive self ligation bracket exhibited no resistance to sliding even in 0.019- 0.025inches stainless steel wire (ss), whereas active self ligation bracket exhibited resistance to sliding in 0.016-0.022 inches ss. With tipping moment in 0.019- 0.025ss, all the bracket designs exhibited resistance to sliding including passive self ligation bracket design**.**

DIFFERENT MODES OF ACCELERATED TOOTH MOVEMENT

Yamasaki et al (1980)[95] conducted animal study followed by clinical application to prove the efficiency of prostaglandins in accelerating the rate of orthodontic tooth movement by mode of increasing alveolar remodeling. Prostaglandins increase the osteoclasts number, thereby favouring bone resorption. Through PGE2 stimulation they stimulate bone formation. They couple bone formation and bone resorption and thus increasing the bone turnover.

Collins et al (1988)[13] found increased rate of tooth movement with injection of Vitamin D metabolite 1,25 dihydroxy chole calciferol in periodontal ligament of cats. Histologically they confirmed it with increased number of osteoclasts

Davidovitch Z (1990)[5] found increased rate of tooth movement with electric current

Liou et al(1998)[31] were the first to introduce periodontal distraction to distalise the canine in 26 patients by cutting the interdental bone through the bur. Customised dental distractor was used to distalise the canine by 6mm in 3 weeks.

Kisnisci RS et al (2002)[33] introduced the technique called dentoalveolar distraction to distalise the canines by making corticotomy cuts in the alveolar bone itself and no cuts were made in the palatal bone and the teeth were allowed to move through the bone.

Cruz et al (2004)[96] conducted a clinical trial and this study revealed the efficiency of low level laser therapy on the rate of orthodontic tooth movement. Low level laser therapy in the infrared region increases the rate of orthodontic tooth movement by photobiomodulation. It results in increasing the ATP levels and thus increasing the energy of cells for remodeling process. The other mode by which they increase the rate of tooth movement is by increasing the vascularity.

Kanzaki et al (2004)[97,98] emphasized that the administration of RANKL (Receptor Activated Nuclear Factor for kappa ligand) by gene therapy increased the rate of tooth movement whereas administration of OPG (osteoprotegrin) by gene therapy decreased the rate of orthodontic tooth movement.

Germec et al (2006)[19] showed 8 months treatment duration and one third treatment time reduction for lower incisor retraction in a class 3 patient with modified corticotomy.

Park et al (2006)[99] introduced the technique called corticision which is malleting the cortex through the incision made by a B.P blade without elevating the flap. The disadvantage of this technique is that the patients had dizziness because of repeated malleting.

Nishimura M (2008)[100] conducted an experiment in witsar rats and found the periodontal activation effect of vibratory force increases the rate of tooth movement.

Kim et al (2009)[101] evaluated effects of corticision on paradental remodelling in orthodontic tooth movement on 16 cats. Histologic and histomorphometric studies showed more direct bone resorption with less hyalinisation in the catabolic phase and more apposition in the anabolic phase.

Dibart et al (2009)[30] introduced the technique called Piezocision. Piezoelectric instrument was used to incise the bone by selective tunnelling along with alveolar bone grafting without elevating the flap was used in this technique.

Bartzela et al (2009)[14] done a systematic review on the effects of medications on the rate of tooth movement**.** Eicosanoids increase tooth movement whereas their blocking drugs like NSAIDS decrease rate of tooth movement. Non NSAIDS like paracetamol has no effect on orthodontic tooth movement. Corticosteroids, Para Thyroid hormone, Vitamin D3 and Thyroxin increase rate of tooth movement. Dietary calcium and Bisphosphonates decrease tooth movement.

Yamaguchi et al (2009)[102] described the role of RANKL (Receptor Activated Nuclear factor for Kappa Ligand) and OPG (Osteoprotegrin) in tooth movement. RANKL is a membrane bound protein on the surface of osteoblasts that binds with RANK (Receptor Activated Nuclear Factor) on the surface of osteoclasts and enhances the osteoclastogenesis. OPG is a receptor produced by osteoblasts that competes with RANK for RANKL binding and thus inhibits osteoclastogenesis. The ratio of OPG and RANKL is important for a balanced action of bone resorption and bone deposition which in turn is important for rate of tooth movement

Mowafy et al 2012[103] used interseptal reduction of bone to distalise canines. He observed difference in the rate of canine retraction between two groups that is one in which intermittent forces were applied using screws as distractors and in other group continuous force were applied using spring as distractor. Canine tipping was completed in 3.5 months with intermittent force application whereas the canine tipping was completed in 7 months in the continuous force group.

Alikhani M et al (2013)[104] conducted randomised control trial to find the molecular changes that happens with microosteoperforations and found increase in cytokines which correlates with Frost concept of regional acceleratory phenomenon.

Long et al (2013)[28] conducted a systematic review to evaluate the effectiveness of 5 interventions for accelerating tooth movement that is, low-level laser therapy, corticotomy, electrical current, pulsed electromagnetic fields, and dentoalveolar or periodontal distraction. Among them, corticotomy is the most

effective and safe procedure to accelerate orthodontic tooth movement. Other procedures lack literature evidence.

Mehr et al (2013)[105] conducted a prospective clinical trial in alignment and leveling of lower anterior crowding with self ligation and observed more reduction of the irregularity index in the first 4 to 5 weeks after piezocision compared with the control group .But no differences existed in the total duration of alignment.

Leethanakul et al 2014[106] conducted a randomised a clinical trial to find the rate of canine retraction with interseptal alveolar reduction and arrived at a conclusion that canine tipping was more in the group with interseptal alveolar reduction.

Yadav et al (2015)[107] conducted an animal study to evaluate the effect of low-frequency mechanical vibration (LFMV) on the rate of tooth movement, bone volume fraction, tissue density and the integrity of the periodontal ligament in 64 CD1 mice .There is no effect on the rate of tooth movement. Micro CT analysis showed increase in bone volume and tissue density. LFMV helped in maintaining the integrity of collagen fibres of periodontal ligament.

Dibart, Keser and Nelson, (2015)[108] reviewed and explained the past, present and future scenario of clinical applications of piezocision in accelerating tooth movement. He also explained the methods of application, indications and contraindications of piezocision.

Peter Miles and Elizabeth Fischer (2016)[11] conducted a randomised a clinical trial and compared the changes in arch perimeter and irregularity in the

mandibular arch during initial alignment with and without the Accel Dent Aura appliance in combination with self ligation brackets which is proposed to accelerate rate of tooth movement by means of vibration and found no difference.

Charavet et al (2016)[109] investigated the effect of piezocision on the rate of tooth movement in patients with mild crowding and revealed the duration was reduced by 43% in the piezocision group than the conventional treatment group.

Aksakalli S et al (2016)[110] found rate of canine distalisation was more in piezocision group than conventional group. There was a decrease in anchorage loss compared to the control group with no changes in the maxillary arch dimensions.

AlSayed, Sultan and Hamadah (2017)[111] evaluated the effectiveness of Low Level Laser Therapy by conducting a randomised control trial .They found laser group showed 26% faster alignment and levelling than the control group.

Jianru Yia et al (2017)[112] reviewed literature and concluded that piezocision increase rate of tooth movement but proper evidence is unavailable.

Medeiros RB et al (2017)[113] found intentional bone injury performed in adult patients undergoing orthodontic treatment is temporary and reversible. Evidence indicates that normal bone features are unchanged.

MATERIALS AND METHODS

SUBJECTS

The study population was selected from outpatient clinic in the Department of Orthodontics & Dentofacial Orthopedics, Tamilnadu Government Dental College & Hospital, Chennai, and TamilNadu, India. Sixteen samples were selected from forty samples with Angles class 1 malocclusion who underwent extraction of first premolar for correction of crowding based on inclusion and exclusion criteria. The selected samples were divided into two groups by systematic random sampling. 8 subjects in group A were treated with self- ligation MBT bracket system and 8 subjects in group B were treated with conventional ligation MBT bracket system .

INCLUSION CRITERIA

- Systemically healthy individuals in permanent dentition.
- Patients with age group: 17 to 23 years.
- Patients belonging to both the gender.
- Patients with Angles class 1 malocclusion and lower anterior space discrepancy of 7 to 10 mm discrepancy according to Careys analysis [114] (Fig 1) which is mostly due to lower anterior crowding. Arch length is measured by passing soft brass wire from mesial surface of first permanent molar, passed over the buccal surfaces of premolars and incisal edges of the anteriors (cingulum of labially inclined anteriors and labial surface of retroclined anteriors) and finally continued to the opposite side in the same manner. Tooth material excess is calculated by subtracting sum of individual tooth width measured with digital vernier caliper from the total arch length.

- Patients with no spaces in the mandibular arch.
- Patients with no therapeutic interventions planned involving intraoral or extraoral appliances including elastics, lip bumpers, headgear.
- Patients willing for voluntary participation and have signed informed consent.
- Patients without prior orthodontic treatment.

EXCLUSION CRITERIA:

- Patients with signs and symptoms of TMJ dysfunction.
- Patients with jaw discrepancy requiring surgical correction.
- Patients with oral manifestation of systemic diseases.
- Cases with deep curve of spee in the lower arch were not considered.
- Cases with posterior crowding were not chosen.

MATERIALS USED

Materials	*Self ligation MBT bracket group*(fig 2)	*Conventional ligation MBT bracket group*(fig3)
Buccal tubes	3m upper triple and lower double buccal tubes	3m upper triple and lower double buccal tubes
Bracket kit	3m Smart clip SL3 bracket kit (passive self ligation)	3m Victory series bracket kit
Prescription	MBT0.022X.028 slot	MBT0.022X.028 slot[41,42,43]
Wires used[85]	0.014inches niti (nickel	0.014 inches niti,

	titanium), 0.016 x 0.022inches niti, 0.019 inches x 0.025 inches Heat activated copper niti 0.019 inches x 0.025 stainless steel	0.018inches niti, 0.019 inches x 0.025 Heat activated copper niti 0.019 inches x 0.025 stainless steel
Modules	_	3m modules
Other instruments used	3m Self ligation wire disengagement plier	_

ORTHODONTIC INSTRUMENTS AND MATERIALS

Orthodontic instruments and materials (fig 4) used includes separator placement plier, 3M separators ,band pusher, posterior band removing plier ,MBT gauge, bracket holder, distal end wire cutter, heavy wire cutter, cheek retractor, Mathew needle holder, ligature director, wire cincher, weingart plier, Light Emitting Diode light curing machine and 3M bonding kit. Preformed bands were used.

MATERIALS USED FOR SELECTIVE ALVEOLAR DECORTICATION

Materials used for selective alveolar decortication(fig 5) includes mouth mirror, Williams periodontal probe, tweezers, kidney tray, cotton bowl, sterilized surgical gloves, sterilized syringe and needle 2 ml, lignocaine solution, BP blade no 15,periosteal elevator, universal curette, curved scissors, straight scissors, saline irrigating syringe, no 6 and 8 bur, no 701 and 702 bur,3.0 braided silk suture, needle holder, cement spatula, periodontal dressing, glass slab, coe pack, micromotor straight handpiece and suction tube.

MATERIALS USED FOR BONE GRAFTING

Materials used for bone grafting (fig 6) includes Osseo graft (Demineralized Freeze Dried Bone Allogenic Graft) manufactured by Advanced Biotech products Ltd, Tamil Nadu, dapen dish, blood of the patient retrieved from the corticotomy site by 2ml syringe.

BRACKET DESCRIPTION[73]

Self ligation bracket used is Smart clip of 3M manufacturers. It consists of two nitinol clips that open and close when inserting or removing arch wire. It is a twin bracket with MBT prescription and 0.022x 0.028 slot. It is a passive self ligating bracket. Victory series bracket of 3M manufacturers is a low profile twin bracket with MBT prescription and 0.022x 0.028 slot.

INVESTIGATIONS

- Basic blood investigation for surgery including bleeding time, Clotting time, Random blood sugar and HIV test were taken. Blood pressure was noted down before surgery as a safety protocol.
- Lateral cephalograms, study models, photographs and Orthopantomographs were taken at two time periods.

  (T0)-Before starting treatment

  (T2)-After completion of alignment and leveling of mandibular arch.

ORTHODONTIC TREATMENT PROTOCOL FOR CALCULATION OF DURATION OF ALIGNMENT AND LEVELING OF MANDIBULAR ARCH

Group matching was done for both the groups. The mean age for self ligating MBT group was 19.625 years and the mean age for conventional

elastomeric MBT group was 19.875 years. Both the groups had 6 females and 2 males. The mean amount of Carey's discrepancy in both the groups was 8 mm and 1.5mm to 2.5mm bite depth cases were chosen.

The following sequence of procedures (fig 7- 14) were followed for both the groups-

T0- Day 1-Before starting the procedure casts, photographs and lateral cephalograms were taken. Lower first molars and second molars were banded with buccal tube welding. Impressions were taken for fabricating lingual arch. (figure 7,11)

↓

Day 4- Lower lingual arch was delivered to the patient.

↓

Day 5- Right first lower premolar extraction was done.

↓

Day 8- Left lower first premolar extraction was done.

↓

Day 11- Bonding was done using same etchant and composite using 3M Transbond composite kit.

↓

Day 12- Corticotomy performed in lower arch (figure 8, 12)

↓

Day 19- **T1**- Securing of first arch wire that is initial aligning wire o14 niti in both groups as suggested by manufacturers was completed. (figure 9,13)

↓

If 014 niti is passive progression to transitional wire that is o18 niti in conventional elastomeric group and 0.016 x 0.022 inches niti in self ligation group was made. If transitional wire is passive progression to leveling wire that is 0.019 x 0.025 inches HANT in both groups was done. If 0.019 x 0.025 inches HANT is passive progression to 0.019 x 0.025 inches stainless steel wire was done.

T2- Day on which mandibular incisors align and level in 0.019 x 0.025 inches stainless steel wire was noted. (figure 10,14)

T1 to T2 - Time duration between T1 and T2 was noted down as alignment and leveling duration of mandibular arch that is time between first day of securing first archwire o14 niti and complete passive engagement of 19x 25 stainless steel wire in both groups.[115,116,117,118]

Alignment was crosschecked with Little's irregularity index[119] (fig 15). Calipers were held parallel to the occlusal plane and the horizontal linear displacement of anatomic contact point to adjacent contact point was measured. The sum of five horizontal linear displacements of proximal surfaces of the lower anteriors between canines was the Little's irregularity index of the arch. Perfect alignment was considered when Little's irregularity index is zero. Little's irregularity score[1] is as follows: 0 is perfect alignment, l to 3 is minimal irregularity, 4 to 6 is moderate irregularity, 7 to 9 is severe irregularity and finally 10 is very severe irregularity. Duration of alignment and leveling was not calculated if irregularity index is not zero to make sure that lower incisors are well aligned and the wire is passive.

EVALUATION OF LOWER INCISOR INCLINATION CHANGES

Mandibular incisor inclination (fig 16) changes[36] induced by alignment and leveling in both groups were evaluated using pre (T0) and post (T2) lateral cephalograms and compared between both the groups. The parameters used were mandibular incisor to mandibular plane (L1-MP), mandibular incisor to nasion-Point B line (L1-NBline) and mandibular incisor to Point A-pogonion line (L1-A-pog).

Cephalometric parameters[120, 121]

Nasion-located on the frontonasal suture in the front region

Point A- Subspinale-the most posterior centre point in the concavity between anterior nasal spine and the prosthion (the lower point on the alveolar bone overlying the upper incisors)

Point B- Supramentale-the most posterior center point in the concavity between the most upper point on the alveolar bone overlying the lower incisors that is infradentale and pogonion

Pogonion-the most front point in the chin

L1-Long axis of the lower incisors

MP[51]-Mandibular Plane-tangent to the lower body of the mandible

L1-MP[51]-Angle formed by the long axis of the lower incisors and the mandibular plane (normal value- 90deg)

L1-Apog-angle formed by the long axis of the lower incisors and the A point-Pogonion line as suggested in Mc-Namara analysis (normal values-23+/-3 degrees)

L1-NB line-angle formed by the long axis of the lower incisors and N point B line as suggested in Steiners analysis (normal values-25 degree)

EVALUATION OF ROOT RESORPTION IN ORTHO PANTO MOGRAPH

Root resorption in both groups after alignment and leveling phase was evaluated using OPG by method suggested by Levander and Malmgren[122] et al (fig 17). Tooth length was measured as the distance from the tip of root apex to the midpoint of the incisal edge. The degree of External Apical Root Resorption (EARR) was assessed using the index given by Levander and Malmgren et al[122]and it is as follows: Score 0 is no changes in the root apex, Score 1is absence of regular root contour, Score 2 is root resorption less than 2 mm, Score 3 is root resorption from 2 mm to one-third of original root length and finally Score 4 is root resorption more than one-third of original root length.

EVALUATION OF POST ALIGNING AND LEVELING MESIO DISTAL ANGULATIONS IN ORTHO PANTOMO GRAPH

Post alignment and leveling mesio distal angulations of lower anterior teeth in PAOO were compared with normal mesio distal angulations of Indian norms as suggested by Poonam Agarwal [123]et al[122]to compare the efficiency of brackets in achieving root parallelism. The method suggested by Ursi et al [124] (fig 18) measures mesio distal angulation of teeth in OPG .A line connecting right and left mental foramen was drawn in OPG. Outline of mandibular ramus and body contour was drawn. Outer contour of the teeth was drawn. Long axis was constructed along the root canal of the teeth .Angle between the long axis of the teeth and the line passing through the mental foramen was measured on the mesial side of the teeth and compared with Indian norms. Normal mesio distal angulation suggested by Poonam Agarwal[123] et al for lower anterior teeth:

Tooth number	43	42	41	31	32	33
Mean	83.73	90.50	90.88	86.95	85.89	81.40
Standard deviation	6.50	6.10	4.62	3.77	4.25	7.36

METHODOLOGY FOR PERIODONTALLY ACCELERATED OSTEOGENIC ORTHODONTICS[125] - SURGICAL TECHNIQUE DESCRIPTION

FLAP DESIGN

Full thickness flap was elevated in the upper 2/3rd of the root portion of teeth and split thickness flap was elevated in 1/3rd root portions of teeth to give access to alveolar bone. Mesial and distal extensions of the flap were elevated to avoid releasing incisions. 2mm of cervical portion of the gingiva was not included to avoid black triangles later.

DECORTICATION

Using a micromotor hand piece with a no2 round bur, corticotomy cuts were made in the buccal and lingual aspects of the alveolar bone .The vertical corticotomy cuts were made between the root prominences of the alveolar bone .These cuts extended from 2 to 3 mm beyond the crest of the alveolar bone to a point 2 mm beyond the root apices. These vertical cuts were connected with horizontal corticotomy cuts .Micro perforations were made over the alveolar bone in between the vertical osteotomy cuts over the radicular surface.

PARTICULATE GRAFTING

- Demineralized Freeze Dried Bone Allogenic graft (DFDBA) was used for bone grafting and after mixing it with blood, it was placed over the

corticotomy cuts.The volume of the graft material used was 0.25 to 0.5 ml of graft material per tooth.

CLOSURE TECHNIQUES

- Flap was closed with 3.0 black silk interrupted sutures.

PATIENT MANAGEMENT

- Antibiotics and analgesics were prescribed for the patient. Application of the icepacks to the affected areas was suggested to the patients to decrease the post-operative severity of swelling or edema. Post-surgical evaluation was done on the next day and after 1 week.

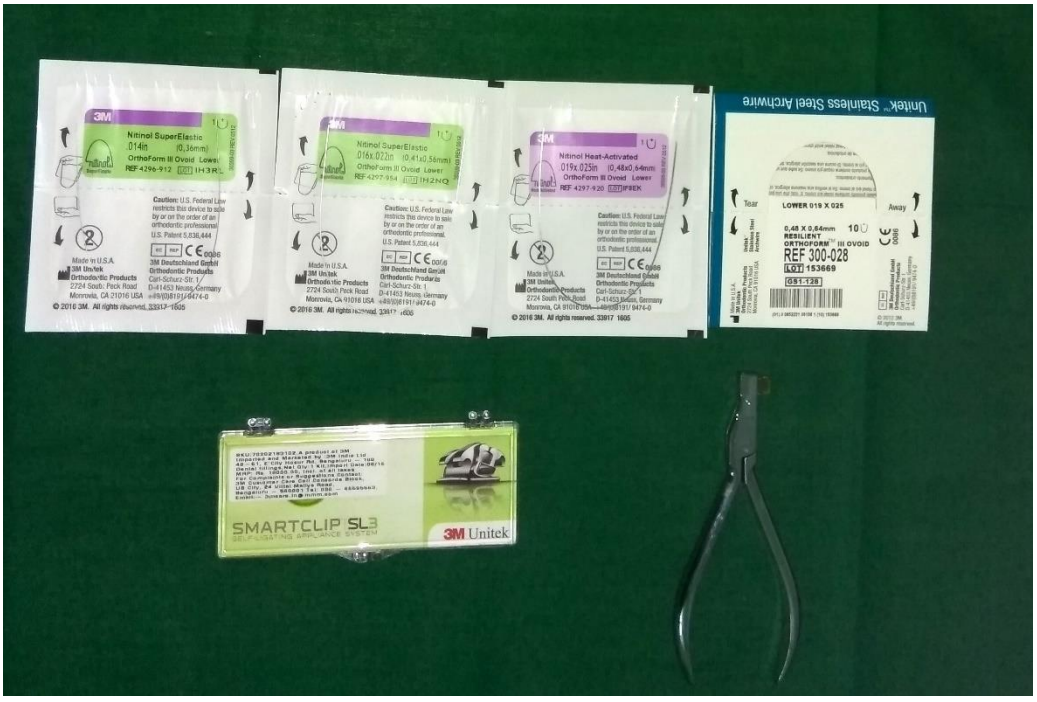
ANALYSIS OF DATA

- Comparisons between the self ligation MBT and conventional elastomeric MBT bracket systems were conducted with the t test or the chi square test depending on the nature of the parameter. Paired T test was used for comparison within the group and unpaired T test was used for inter group comparison. Group matching was done with unpaired T test.Treatment duration for alignment and leveling of the mandibular crowding in both bracket systems was investigated with unpaired T test and statistical methods for survival analysis .Descriptive statistics and Mann Whitney test were used when the variables didn't follow normal distribution. Pearson correlation was used to find the correlation between amount of crowding and treatment duration for alignment and leveling. SPSS 22 PACKAGE was used. Significance level was fixed as 5% ($\alpha = 0.05$).

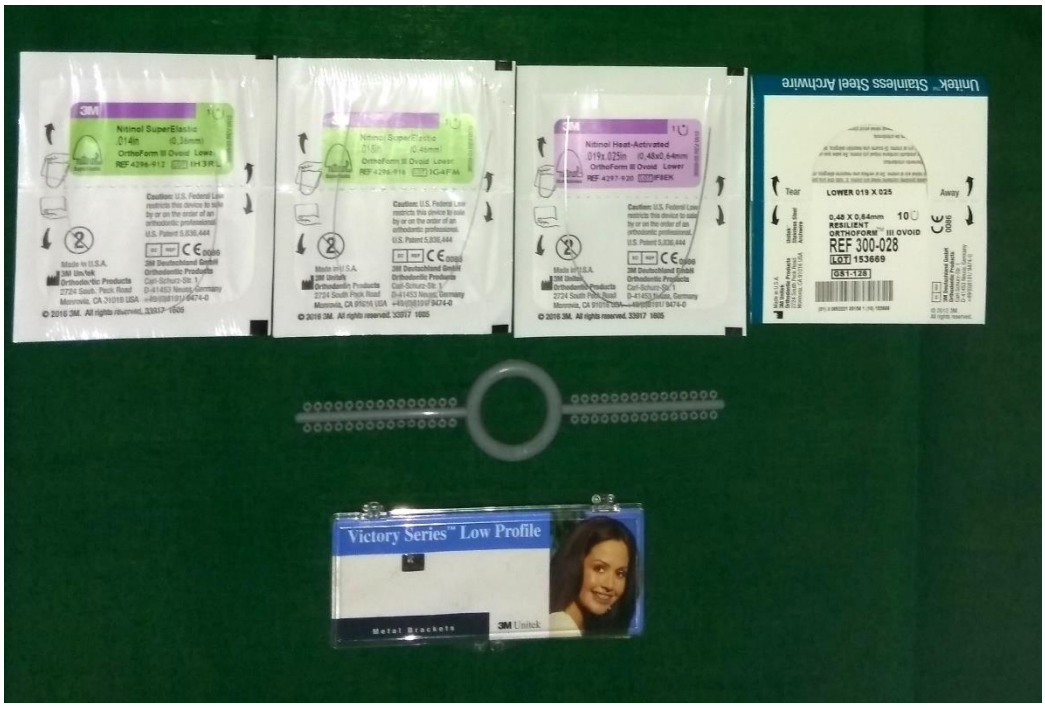
COLOR PLATES

1. CAREYS ANALYSIS

2. SELF LIGATION BRACKETS, DISENGAGEMENT INSTRUMENT, ARCHWIRE SEQUENCE



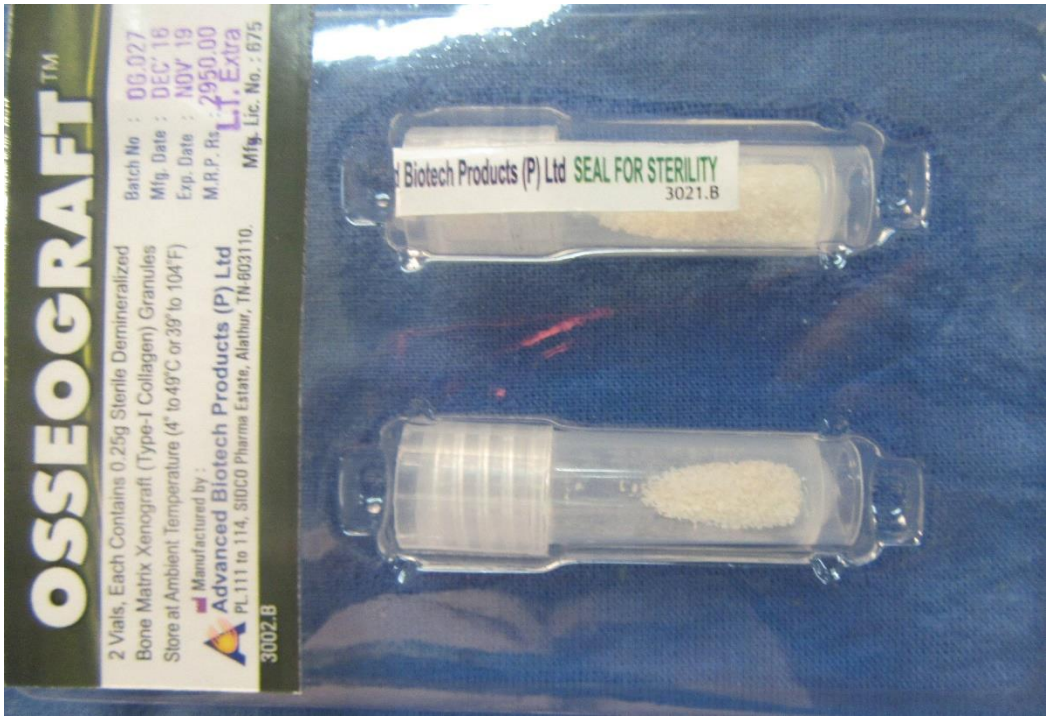
3. CONVENTIONAL ELASTOMERIC BRACKETS, ARCH WIRE SEQUENCE AND MODULES



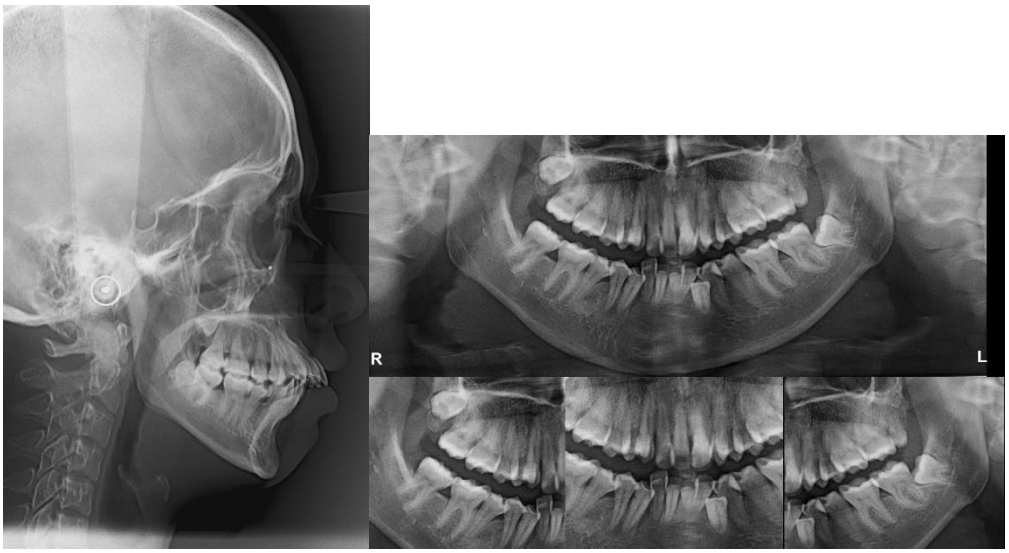
4. ORTHODONTIC MATERIALS USED FOR BANDING AND BONDING

5. MATERIALS USED FOR SELECTIVE ALVEOLAR DECORTICATION AND ALVEOLAR BONE GRAFTING

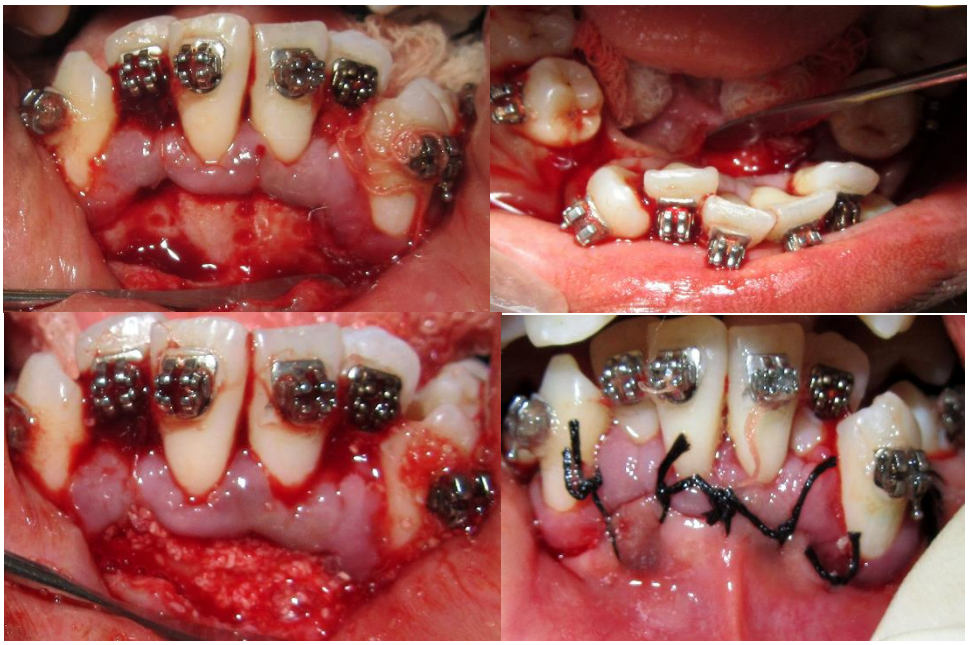
6. OSSEOGRAFT



7. PRE TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF SELF LIGATION MBT BRACKET SYSTEM AT T0

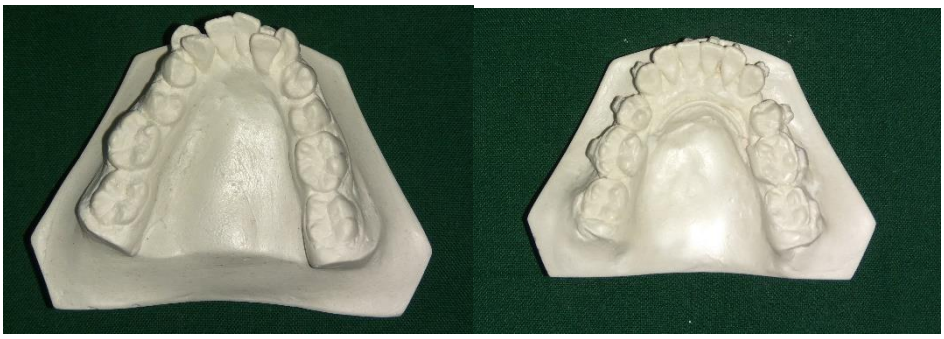


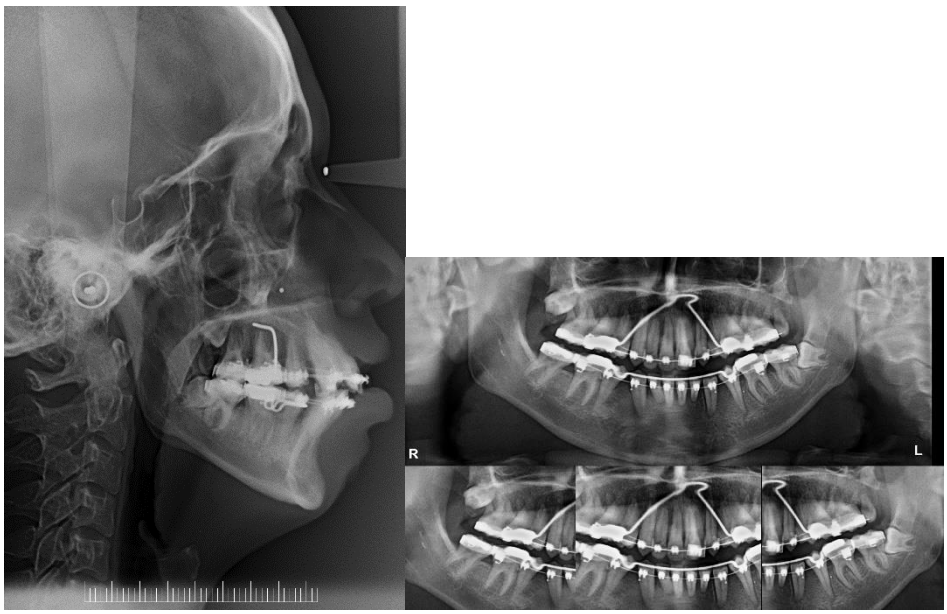
8. CORTICOTOMY PHOTOS OF REPRESENTATIVE SAMPLE OF SELF LIGATING GROUP



9. TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF SELF LIGATION MBT BRACKET SYSTEM AT T1

10. TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF SELF LIGATION MBT BRACKET SYSTEM AT T2

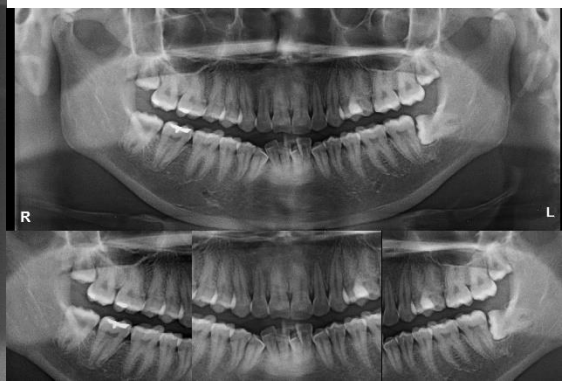




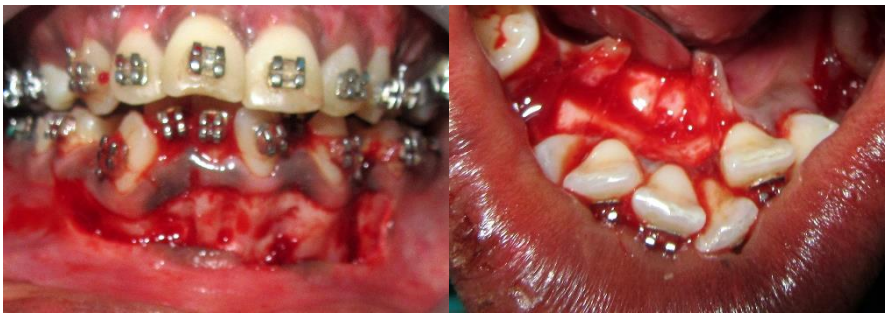
11. PRE TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF CONVENTIONAL MBT BRACKET SYSTEM AT T0





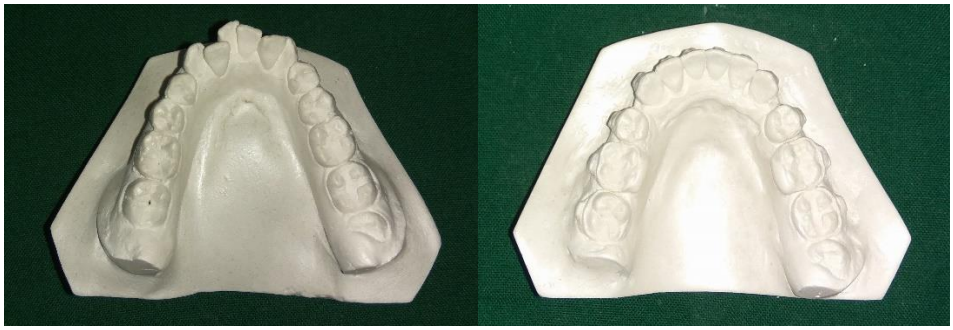



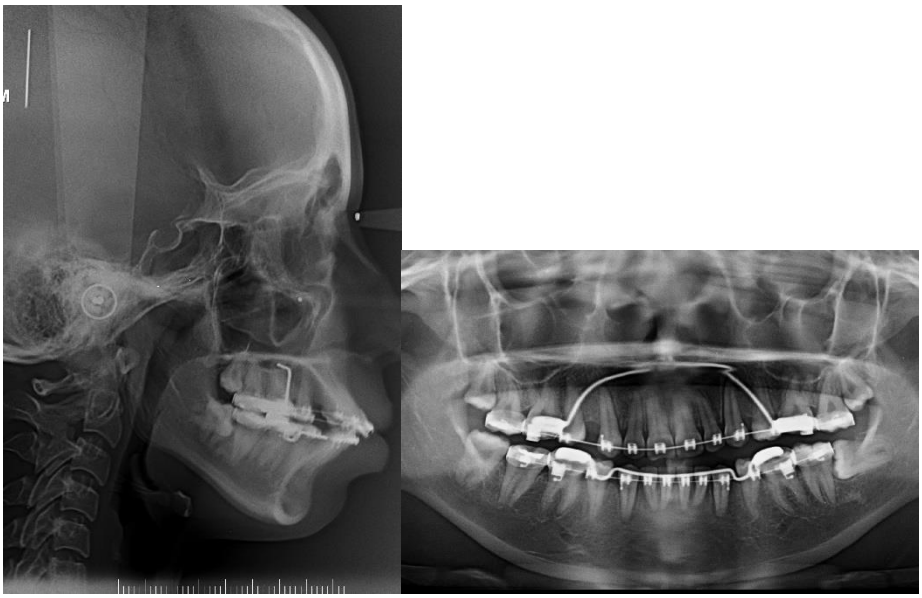
12. CORTICOTOMY PHOTOS OF REPRESENTATIVE SAMPLE OF CONVENTIONAL MBT



13. TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF CONVENTIONAL MBT BRACKET SYSTEM AT T1

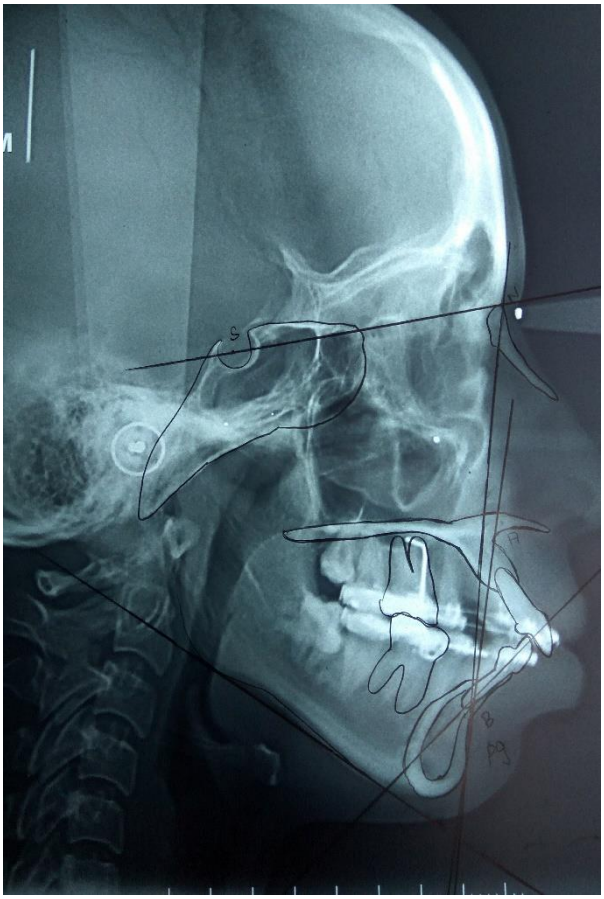
14. TREATMENT PHOTOS OF REPRESENTATIVE SAMPLE OF CONVENTIONAL MBT BRACKET SYSTEM AT T2



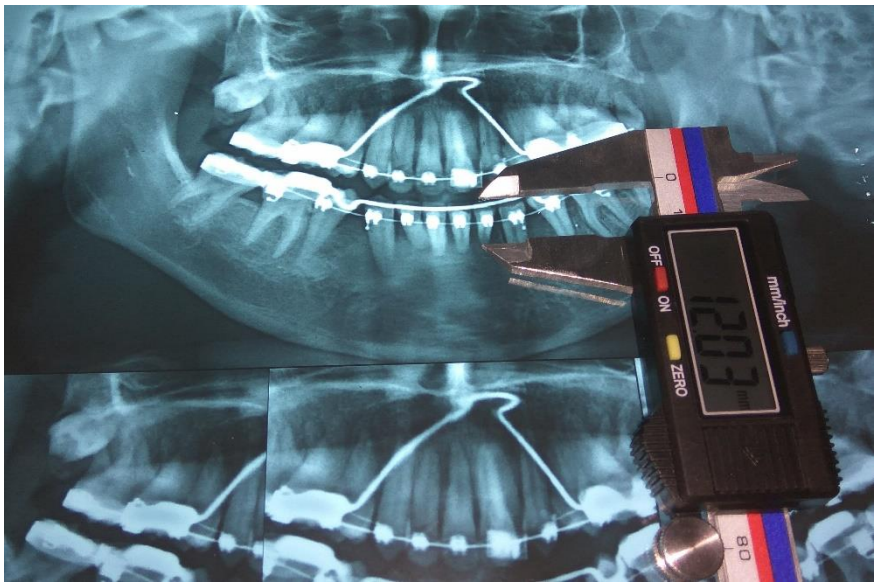


15. MEASURING LITTLE'S IRREGULARITY INDEX

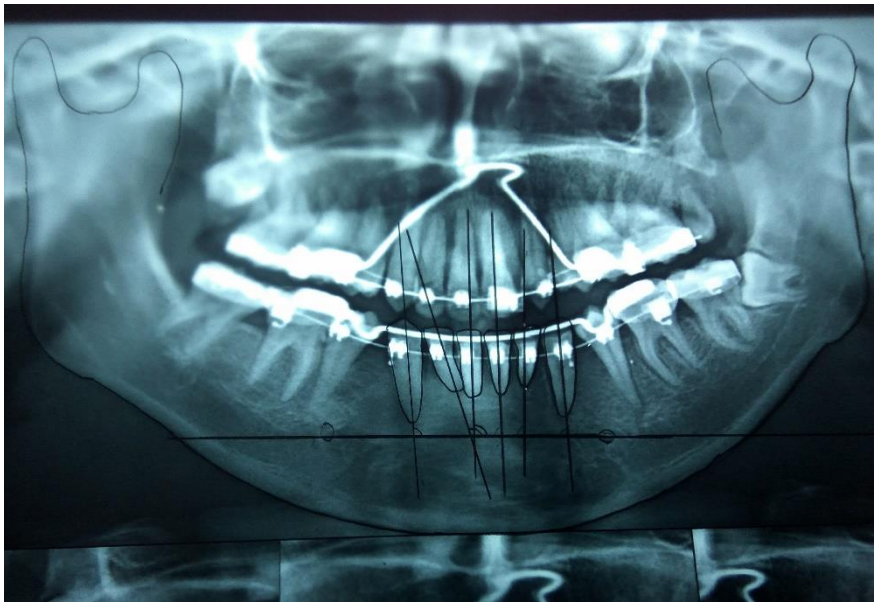
16. POST TREATMENT INCLINATION



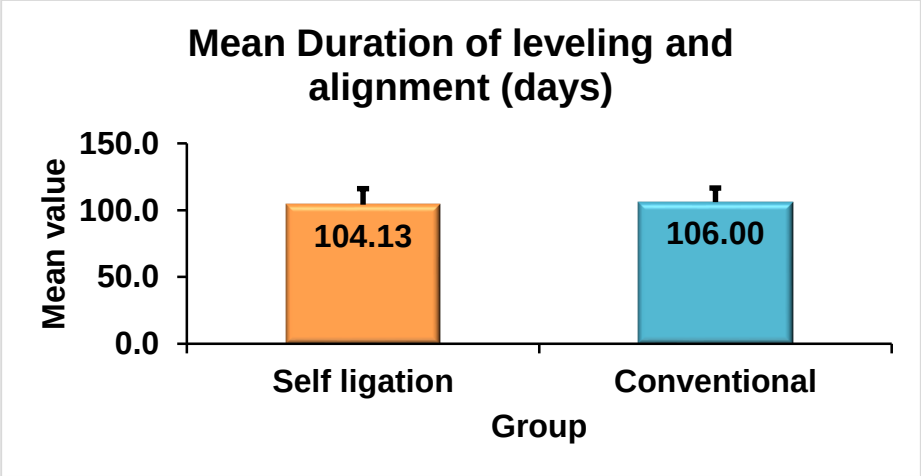
17. MEASURING TOOTH LENGTH FOR CALCULATING ROOT RESORPTION - METHOD BY LEVANDER AND MALMGREN ET AL



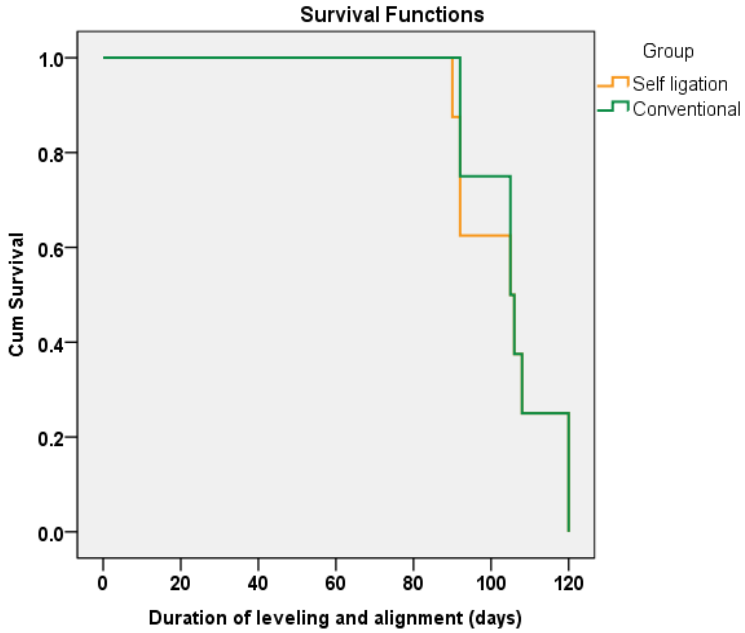
18. CALCULATION OF POST TREATMENT ANGULATION –METHOD BY URSI ET AL



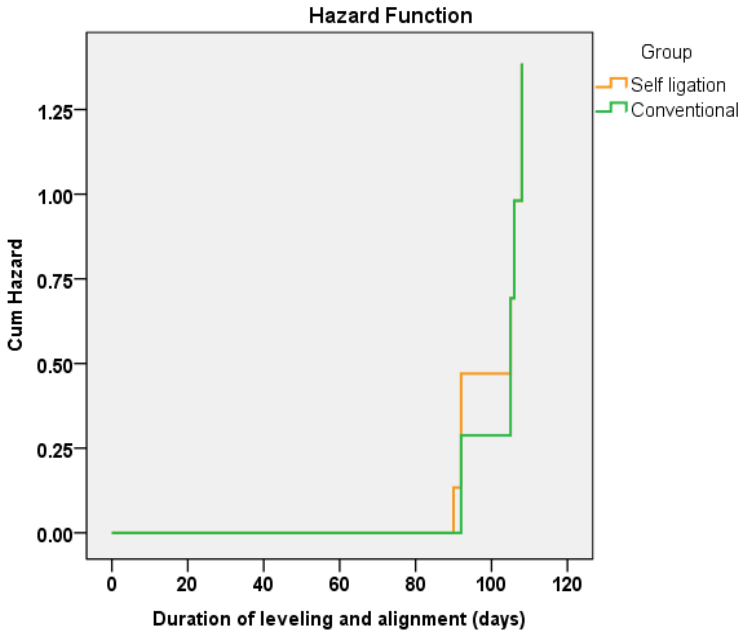
19. BAR DIAGRAM SHOWING COMPARISON OF MEAN DURATION OF ALIGNMENT AND LEVELING BETWEEN CONVENTIONAL LIGATION AND SELF LIGATION GROUPS



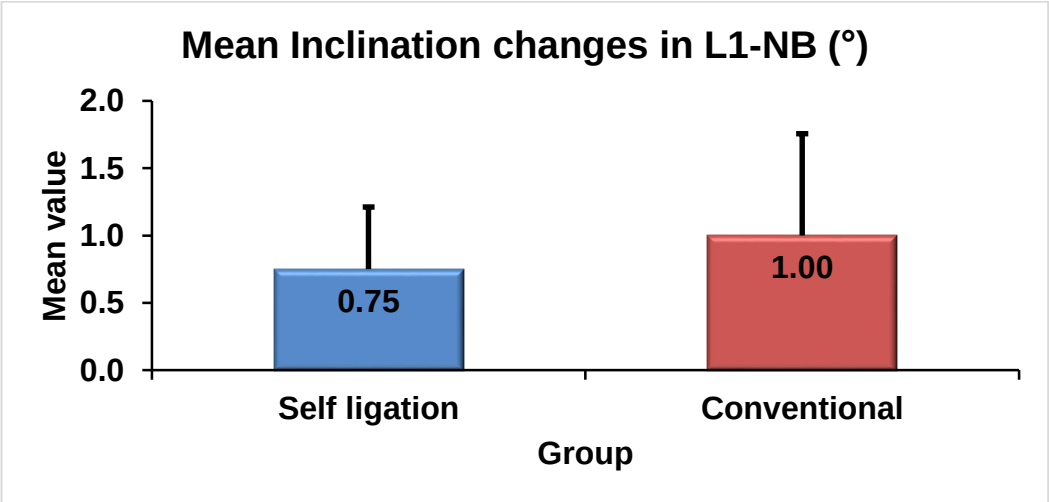
20. BAR DIAGRAM SHOWING SURVIVAL FUNCTION FOR DURATION OF ALIGNMENT AND LEVELING IN CONVENTIONAL AND SELF LIGATION GROUPS



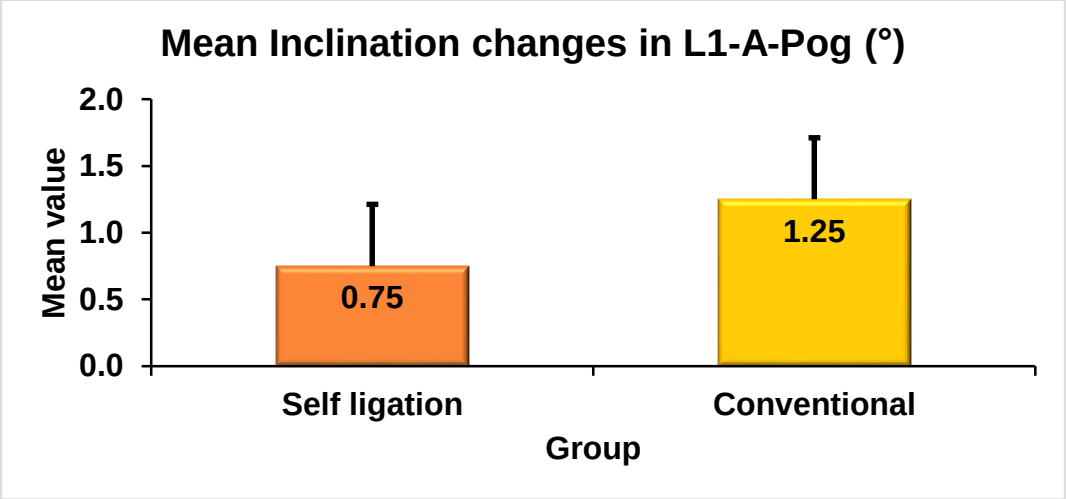
21. BAR DIAGRAM SHOWING HAZARD FUNCTION FOR DURATION OF ALIGNMENT AND LEVELING IN CONVENTIONAL AND SELF LIGATION GROUPS



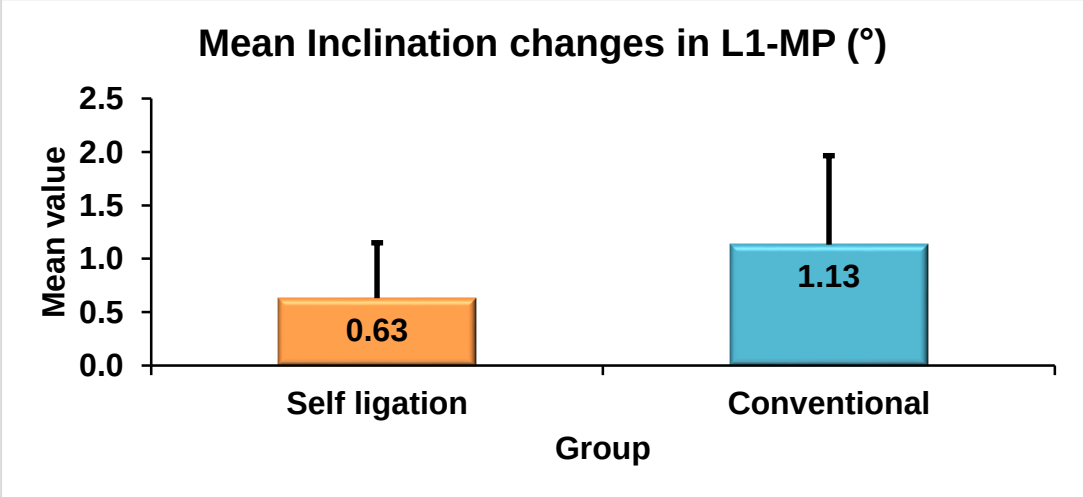
22. BAR DIAGRAM SHOWING MEAN INCLINATION CHANGES IN LOWER INCISOR TO NASION B POINT IN CONVENTIONAL AND SELF LIGATION GROUPS



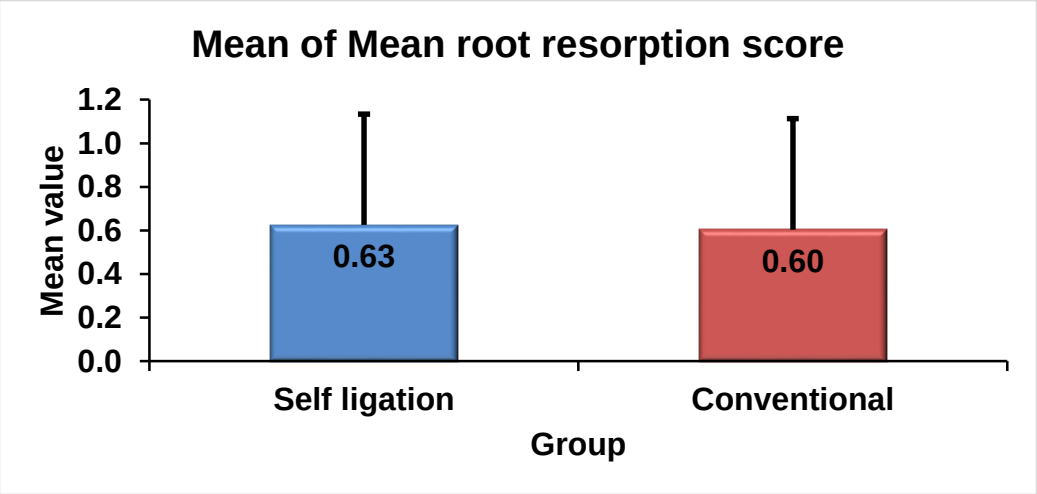
23. BAR DIAGRAM SHOWING MEAN INCLINATION CHANGES IN LOWER INCISOR TO A POINT POGONION PLANE IN CONVENTIONAL AND SELF LIGATION GROUPS



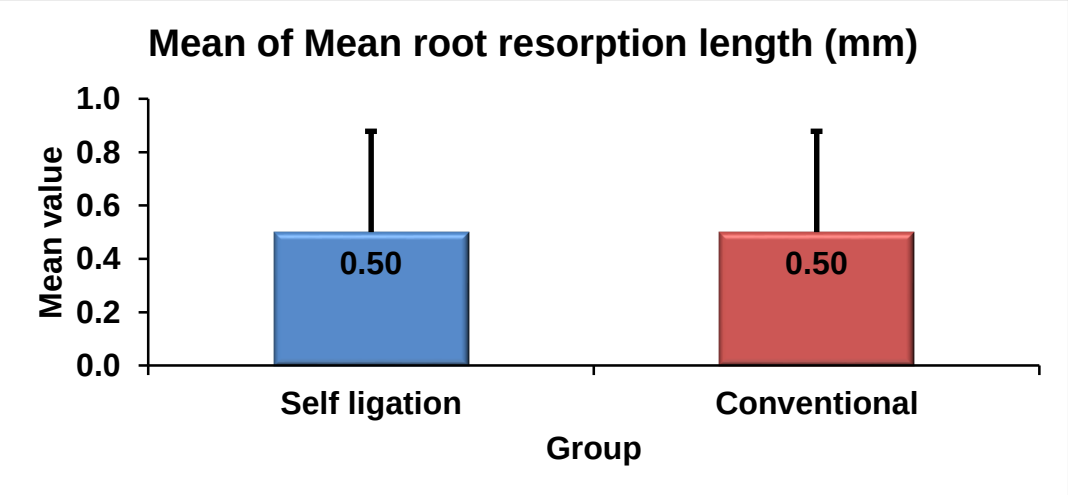
24. BAR DIAGRAM SHOWING MEAN INCLINATION CHANGES IN LOWER INCISOR TO MANDIBULAR PLANE IN CONVENTIONAL AND SELF LIGATION GROUPS



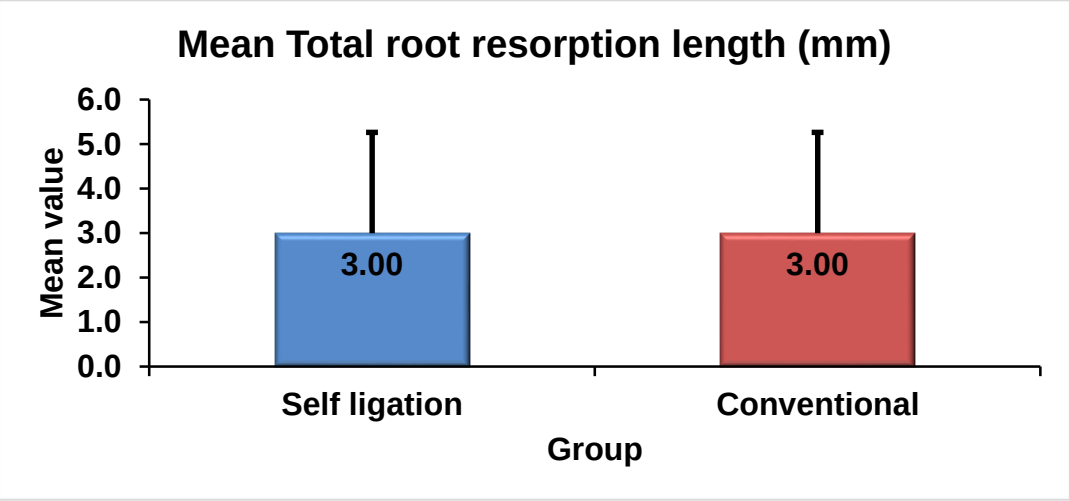
25. BAR DIAGRAM SHOWING MEAN OF MEAN ROOT RESORPTION SCORE IN CONVENTIONAL AND SELF LIGATION GROUPS



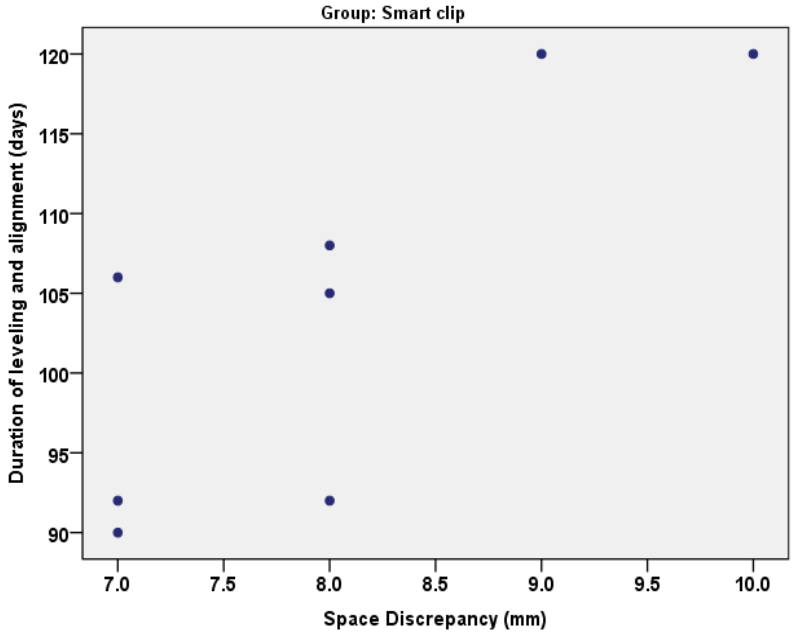
26. BAR DIAGRAM SHOWING MEAN OF MEAN ROOT RESORPTION LENGTH IN CONVENTIONAL AND SELF LIGATION GROUPS



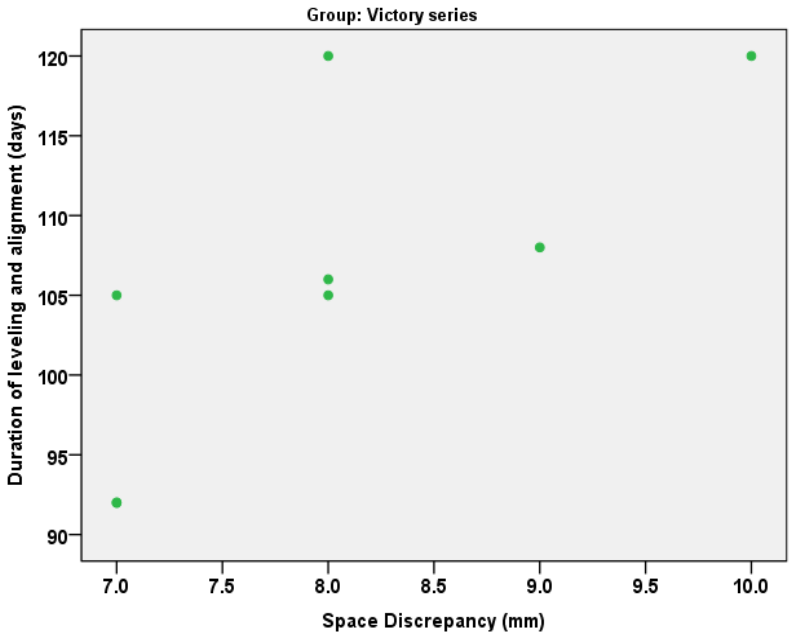
27. BAR DIAGRAM SHOWING MEAN TOTAL ROOT RESORPTION LENGTH IN CONVENTIONAL AND SELF LIGATION GROUPS



28. BAR DIAGRAM SHOWING CORELATION BETWEEN SPACE DISCREPANCY AND DURATION OF ALIGNMENT AND LEVELING IN SELF LIGATION GROUP



29. BAR DIAGRAM SHOWING CORELATION BETWEEN SPACE DISCREPANCY AND DURATION OF ALIGNMENT AND LEVELING IN CONVENTIONAL MBT GROUP



RESULTS

Both the groups were matched for age, gender, and mean space discrepancy. Age and space discrepancy were matched by independent T test. Gender was matched by chi-square test. Treatment duration for alignment and leveling of mandibular crowding between self ligation MBT(Smart clip) bracket group and the conventional elastomeric MBT bracket group (Victory series) in periodontally accelerated osteogenic orthodontics was investigated with unpaired student t test (parametric test) and Kaplan-Meier Survival analysis(parametric test). Space discrepancy and duration of alignment and leveling were correlated with Pearson correlation coefficient. Paired Samples t-test was used to compare mean values of lower incisor inclination between pre-treatment (T0) and Post treatment (T2) within the group. Inclination changes, mean root resorption score, mean root resorption length and total resorption length per patient were investigated with conventional descriptive statistics. Mann Whitney test (non-parametric test) was used to compare inclination changes, mean root resorption score, mean root resorption length and total resorption length per patient between the groups since the Normality tests Kolmogorov-Smirnov and Shapiro-Wilk tests results revealed that they did not follow Normal distributions. SPSS version 22.0 was used to analyse the data. Significance level was fixed as 5% ($\alpha = 0.05$).

TABLE 1 shows raw data of patients in the self ligating MBT group.

TABLE 2 shows raw data of patients in the conventional elastomeric MBT group.

TABLE 3 shows raw data of post alignment and leveling mesio distal angulations of lower anterior teeth in self ligating MBT group in degrees.

TABLE 4 shows raw data of post alignment and leveling mesio distal angulations of lower anterior teeth in conventional elastomeric MBT group in degrees.

TABLE 5 shows independent samples t-test to compare mean values of age and space discrepancy between self ligating MBT group and conventional MBT group. P value of 0.820 shows that both groups have been matched for age and space discrepancy in the lower arch.

TABLE 6 shows Chi-square test to compare gender proportions between groups.

P value of 1.000 of Chi square test shows that there was no gender difference between the groups and in both groups there were 75% females and 25% were males.

The results are discussed under four different headings.

1. Assessment and comparison of treatment duration of alignment and leveling of mandibular arch between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO
2. Comparison of post alignment and leveling lower incisor inclination changes within the group as well as between self ligation MBT bracket group and conventional elastomeric MBT bracket group (pre-treatment T0 and post treatmentT2) in PAOO.

3. Comparison of post alignment and leveling lower anterior root resorption levels within the groups as well as between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO.
4. Comparison of post alignment and leveling lower anterior mesio distal angulation changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO.

I. ASSESSMENT AND COMPARISON OF TREATMENT DURATION OF ALIGNMENT AND LEVELING OF MANDIBULAR ARCH BETWEEN SELF LIGATION MBT BRACKET GROUP AND CONVENTIONAL ELASTOMERIC MBT BRACKET GROUP IN PAOO (figure 19,20.21)

- The results have shown that there is no difference in treatment duration of alignment and leveling between both the appliance groups.

TABLE 7 shows Independent samples T-Test to compare mean values of alignment and leveling duration of mandibular arch between groups**.** Mean treatment duration for alignment and leveling in the mandibular arch in self ligation MBT group is 104.13 days. Mean treatment duration for alignment and leveling in the mandibular arch in conventional MBT group is 106 days .Statistically insignificant differences were found in the duration of alignment and leveling in mandibular arch between groups. P value-0.746 (figure 19)

TABLE 8 shows Means for survival time for self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics by Kaplan-Meier survival analysis. Estimate of mean for survival time for self ligation smart clip group is 104.125 days with lower bound of 95.773 days and upper bound of 112.477days and for conventional

elastomeric MBT group is 106.000 days with lower bound of 98.638 days and upper bound of 113.362 days.

TABLE 9 shows Medians for survival time for self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics by Kaplan-Meier survival analysis. Estimate of median for survival time for self ligation smart clip group is 105 days with lower bound of 85.597 days and upper bound of 124.403 and for conventional elastomeric MBT group is 105.000 days with lower bound of 92.065 days and upper bound of 117.935 days.

TABLE 10 shows overall comparisons of survival time for self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO by Kaplan-Meier survival analysis. Log Rank (Mantel-Cox) test for comparing survival time for both groups shows statistically insignificant difference between groups (p value-0.863). Breslow (Generalized Wilcoxon) test for comparing survival time for both groups shows statistically insignificant difference between groups (p value-0.750). Tarone-Ware test for comparing survival time for both groups shows statistically insignificant difference between groups (p value-0.805). No synergistic effect is observed in self ligation MBT group in alignment and leveling phase when combined with periodontally accelerated osteogenic orthodontics with respect to treatment duration compared to conventional MBT group (figure 20, 21).

TABLE 11 shows Pearson correlation between space discrepancy and duration of alignment and leveling. Results have shown that there is a positive correlation between space discrepancy and treatment duration of alignment and

leveling that is duration of alignment and leveling of mandibular arch increases with space discrepancy. Pearson corelation of self ligation group is 0.798 and conventional elastomeric ligation group is 0.742.Pearson corelation shows that p value is 0.018 in self ligation group and 0.035 in conventional elastomeric ligation group indicating that there is a positive corelation between space discrepancy and treatment duration of alignment and leveling that is duration increases with space discrepancy.(figure 28,29)

II. COMPARISON OF POST ALIGNMENT AND LEVELING LOWER INCISOR INCLINATION CHANGES WITHIN THE GROUP AS WELL AS BETWEEN SELF LIGATION MBT BRACKET GROUP AND CONVENTIONAL ELASTOMERIC MBT BRACKET GROUP IN PAOO

(figure 22,23,24)

- Statistically significant differences were found between pre (T0) and post treatment (T2) lower incisor inclination within the group in both bracket systems that is both caused retroclination of lower incisors lingually.

- Statistically insignificant differences were found in lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group.

TABLE 12 shows Paired Samples t-test to compare mean values between pre-treatment (T0) and post treatment (T2) lower incisor inclination values within the groups. Significant differences exist in lower incisor inclination values between pre–treatment (T0) and post- treatment values (T2) within the self ligation MBT group with respect to L1-MP (Mandibular incisor to mandibular

plane, p value-0.011) L1-NB (mandibular incisor to nasion-Point B line, p value-0.003)and L1-A-Pog, (mandibular incisor to Point A-pogonion line p value-0.003).Significant differences exist in lower incisor inclination values between pre -treatment(T0) and post- treatment values (T2)within the conventional MBT group with respect to L1-MP (Mandibular incisor to mandibular plane ,p value-0.007) L1-NB (mandibular incisor to nasion-Point B line, p value-<0.001)and L1-A-Pog, (mandibular incisor to Point A-pogonion line p value-0.007).

TABLE 13 shows descriptive Statistics to compare lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO. Descriptive statistics showed differences exist in lower incisor inclination changes[between pre -treatment(T0) and post- treatment values (T2)]between self ligation MBT bracket group and conventional elastomeric MBT bracket group with respect to L1-MP (Mandibular incisor to mandibular plane, self ligation MBT is -0.625 degrees and conventional MBT is -1.125degrees) L1-A Pog(mandibular incisor to nasion-Point B line self ligation MBT is -0.750degreesand conventional MBT is -1.250)and L1-NB, (mandibular incisor to Point A-pogonion line self ligation MBT is -0.750degrees and conventional MBT is -1.000degrees)

TABLE 14 shows Mann – Whitney test to compare lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics. Statistically insignificant differences exist in lower incisor inclination changes[between pre -treatment(T0) and post- treatment values (T2)]between self ligation MBT bracket group and conventional elastomeric MBT

bracket group with respect to L1-MP (Mandibular incisor to mandibular plane ,p value0.188) L1-NB (mandibular incisor to nasion-Point B line, p value -0.053)and L1-A-Pog, (mandibular incisor to Point A-pogonion line p value-0.464).

III. <u>COMPARISON OF POST ALIGNMENT AND LEVELING LOWER ANTERIOR ROOT RESORPTION LEVELS WITHIN THE GROUPS AS WELL AS BETWEEN SELF LIGATION MBT BRACKET GROUP AND CONVENTIONAL ELASTOMERIC MBT BRACKET GROUP IN PAOO</u>

(figure 25, 26and 27)

- Statistically insignificant differences exist in root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO.

TABLE 15 shows Descriptive Statistics to compare root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO. Descriptive statistics showed differences exist in root resorption levels[between pre –treatment (T0) and post- treatment values (T2)]between self ligation MBT bracket group and conventional elastomeric MBT bracket group with respect to mean root resorption score, (self ligation MBT 0.625 degrees and conventional MBT-0.604), mean root resorption length in millimetres (self ligation MBT -0.500 and conventional MBT-0.500) and total root resorption length in millimetres (self ligation -3.000 and conventional -3.000).

TABLE 16 shows Mann Whitney test to compare root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics. Statistically insignificant differences exist in root resorption levels [between pre–treatment

(T0) and post- treatment values (T2)]between self ligation MBT bracket group and conventional elastomeric MBT bracket group with respect to mean root resorption score, (p value-0.828), mean root resorption length in millimetres (p value-1.000) and total root resorption length in millimetres (p value-1.000).

TABLE 17 shows multiple response analysis to show the tooth more prone to root resorption within the group and between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics. Multiple response analysis showed lower left lateral incisor (self ligation MBT 66.7 percent of cases and conventional MBT-66.7 percent of cases) had more root resorption followed by right lower lateral incisor. (Self ligation MBT -50% of cases and conventional MBT-33.3% of cases). Both lower central incisors showed root resorption in both groups. (Self ligation MBT 33.3% of cases and conventional MBT-33.3% of cases).Left lower canines didn't show any root resorption whereas right lower canines showed resorption in certain cases in both groups. (Self ligation MBT 16.7% of cases and conventional MBT-16.7% of cases). Lower lateral incisors showed more root resorption than lower central incisors .Root resorption in canines in both groups is very rare.

IV. COMPARISON OF POST ALIGNMENT AND LEVELING LOWER ANTERIOR MESIO DISTAL ANGULATION CHANGES BETWEEN SELF LIGATION MBT BRACKET GROUP AND CONVENTIONAL ELASTOMERIC MBT BRACKET GROUP IN PAOO

- Statistically insignificant differences exist between both the groups with respect to fitting of post treatment mesio distal angulation into Indian norms.

TABLE 18 shows multiple response analysis to indicate number of teeth fitting into Indian norms and the teeth which did not fit into Indian norms of normal mesio distal angulations after alignment and leveling.

TABLE 19 shows multiple response analysis to indicate number of teeth fitting into Indian norms and the teeth which did not fit into Indian norms of normal mesio distal angulations after alignment and leveling. Fischer exact chi square test showed 62.5% of self ligation post treatment lower anterior teeth mesio distal angulation fit into Indian norms whereas 37.5% did not fit. 75% of conventional MBT post treatment lower anterior teeth mesio distal angulation fit into Indian norms whereas 25% did not fit .Though conventional MBT achieved greater success in post alignment and leveling mesio distal angulations than self ligation group statistically insignificant differences exist because of smaller sample size. Lower lateral incisors were the most common teeth which do not fit into mesio distal angulations of Indian norms.

Results:

1. Average time for alignment and leveling in the mandibular arch in self ligation MBT group in PAOO is 104.13 days.
2. Average time for alignment and leveling in the mandibular arch in conventional MBT group in PAOO is 106 days.
3. Statistically insignificant differences were found in the duration of alignment and leveling in mandibular arch between groups. p value-0.746
4. No synergism was observed with self ligation MBT brackets in alignment and leveling phase in PAOO with respect to treatment duration compared to conventional MBT brackets.

5. Statistically significant differences were found between pre(T0) and post treatment (T2) lower incisor inclination within the group in both bracket systems that is both the groups had shown retroclination of lower incisors in PAOO.

6. Statistically insignificant differences were found in lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group.

7. Statistically insignificant differences exist in root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in PAOO.

8. Lower lateral incisors showed more root resorption than lower central incisors in both groups in PAOO**.** Root resorption in canines in both groups was very rare.

9. Fischer exact chi square test showed 62.5% of self ligation and 75% of conventional MBT post treatment lower anterior teeth mesio distal angulation fit into Indian norms. 37.5% of self ligation and 25% of conventional MBT post treatment lower anterior teeth mesio distal angulation did not fit into Indian norms. Though conventional MBT achieves greater success in post alignment and leveling mesio distal angulations than self ligation group statistically insignificant differences exist because of smaller sample size. Lower lateral incisors were the most common teeth which did not fit into mesio distal angulations of Indian norms.

TABLES FOR RESULTS

TABLE 1 - Raw data of patients in the self ligating MBT group

Patient number	1	2	3	4	5	6	7	8
Age	21	17	19	20	18	22	23	17
Gender	f	f	m	f	f	f	f	m
Space discrepancy mm	10	8	7	9	8	7	7	8
Duration of alignment and leveling in days T1-T2	120	92	106	120	108	92	90	105
Pre post T0-T2 angulation change L1-MP in degrees	-1	0	-1	0	-1	-1	0	-1
Pre post T0-T2 angulation change L1-A-Pog in degrees	-1	-1	-1	-1	-1	0	-1	0
Pre post T0-T2 angulation change L 1-NB in degrees	0	-1	-1	-1	0	-1	-1	-1
Mean root	1.33	0	0.5	0.67	0	0.67	1.33	0.5

resorption score								
Mean root resorption length mm	1	0	0.5	0.5	0	0.5	1	0.5
Total root resorption length mm	6	0	3	3	0	3	6	3
Tooth with root resorption	31,32, 41	0	42	32.42	0	32, 43	31,32 ,41	42
Number of teeth fitting into Indian Norms mesio distal angulation	4 out of 6	4 out of 6	0 out of 6	0 out of 6	4 out of 6	4 out of 6	4 out of 6	0 out of 6
Which teeth do not fit into norms mesio distal angulation	32,42	32,42	31,32, 33,41, 42,43	31,32 ,33, 41,42,43	32,42	32, 42	32, 42	31,32, 33,41, 42,43

TABLE 2 - Raw data of patients in the conventional elastomeric MBT group

Patient number	1	2	3	4	5	6	7	8
Age	18	17	23	19	20	21	22	19
Gender	f	f	f	m	f	f	f	m
Space discrepancy mm	7	10	9	7	8	8	7	8

Duration of alignment and leveling in days T1-T2	92	120	108	92	106	120	105	105
Pre post T0-T2 angulation change L1-MP in degrees	-2	-1	0	-2	-1	0	-2	-1
Pre post T0-T2 angulation change L1-A-Pog in degrees	-2	-1	-1	-2	-1	-1	-1	-1
Pre post T0-T2 angulation change L 1-NB in degrees	-2	-1	0	-2	-1	0	-1	-1
Mean root resorption score	0.67	0.5	0	1.33	0	1.33	0.5	0.5
Mean root resorption length mm	0.5	0.5	0	1	0	1	0.5	0.5
Total root resorption length mm	3	3	0	6	0	6	3	3
Tooth with root resorption	32,43	42	-	31,32, 41	-	31,32, 41	32	42
Number of teeth	4 out	4 out	4out	4 out	0 out	4 out	4	0 out

fitting into Indian Norms angulation	of 6	of 6	of 6	of 6	of 6	of 6	out of 6	of 6
Which teeth do not fit into norms angulation	32,42	32,42	32,42	32,42	31,32, 33,41, 42,43	32,42	32, 42	31,32, 33,41, 42,43

TABLE 3 - Post alignment and leveling mesio distal angulations of lower anterior teeth in self ligating MBT group in degrees

Patient number and tooth number	**43**	**42**	**41**	**31**	**32**	**33**
1	84	98	88	90	100	88
2	86	102	89	90	92	88
3	91	97	96	92	92	89
4	92	98	97	93	93	90
5	85	99	89	90	101	88
6	87	103	90	90	93	88
7	86	102	89	90	92	88
8	93	99	98	94	94	91

TABLE 4 - Post alignment and leveling mesio distal angulations of lower anterior teeth in conventional elastomeric MBT group in degrees

Patient number and tooth number	**43**	**42**	**41**	**31**	**32**	**33**
1	84	98	88	90	100	88
2	86	102	89	90	92	88
3	87	103	90	90	93	88

4	85	99	89	90	101	88
5	92	98	98	93	92	90
6	83	97	87	89	99	87
7	86	102	89	90	92	88
8	91	98	97	92	93	89

TABLE 5 - Independent samples t-test to compare mean values of age and space discrepancy between groups

Variables	Group	N	Mean	Std. Dev	t-Value	p-Value
Age (years)	Self ligation	8	19.63	2.264	0.232	0.820
	Conventional	8	19.88	2.031		
Space Discrepancy (mm)	Self ligation	8	8.00	1.069	0.000	1.000
	Conventional	8	8.00	1.069		

P value of 0.820 shows that both groups have been matched for age and space discrepancy in the lower arch

TABLE 6 - Chi-square test to compare gender proportions between groups

Gender	Group					
	Self ligation		Conventional		Total	
	N	%	N	%	N	%
Male	2	25.0%	2	25.0%	4	25.0%
Female	6	75.0%	6	75.0%	12	75.0%
Total	8	100.0%	8	100.0%	16	100.0%

Chi-Square Test	p-Value
Fisher's Exact Test	1.000

P value of 1.000 of Chi square test shows that there is no gender difference between the groups and in both groups there are 75% are females and 25% are males.

TABLE 7 - Independent samples T-Test to compare mean values of alignment and leveling duration of mandibular arch between groups (figure 19)

Variables	Group	N	Mean	Std. Dev	t-Value	p-Value
Duration of leveling and alignment (days)	Self ligation	8	104.13	12.053	0.330	0.746
	Conventional	8	106	10.623		

Statistically insignificant differences were found in the duration of alignment and leveling in mandibular arch between groups. p value-0.746

TABLE 8 - Means for survival time between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics by Kaplan-Meier survival analysis in alignment and leveling phase

Group	Mean			
	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Self ligation	104.125	4.261	95.773	112.477
Conventional	106.000	3.756	98.638	113.362
Overall	105.063	2.754	99.664	110.461

Estimate of mean for survival time for self ligation smart clip group is 104.125 days and for conventional elastomeric MBT group is 106.000 days

TABLE 9 - Medians for survival time between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics by Kaplan-Meier survival analysis in alignment and leveling phase

Group	Median			
	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Self ligation	105.000	9.899	85.597	124.403
Conventional	105.000	6.600	92.065	117.935
Overall	105.000	5.600	94.024	115.976

Estimate of median for survival time for self ligation smart clip group is 105 days with lower bound of 85.597 days and upper bound of 124.403 and for conventional elastomeric MBT group is 105.000 days with lower bound of 92.065 days and upper bound of 117.935 days.

TABLE 10 - Overall comparisons for survival time between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics by Kaplan-Meier survival analysis in alignment and leveling phase

	Chi-Square	P-Value
Log Rank (Mantel-Cox)	.030	.863
Breslow (Generalized Wilcoxon)	.102	.750
Tarone-Ware	.061	.805

Log Rank (Mantel-Cox) test, Tarone-Ware test and Breslow (Generalized Wilcoxon) test for comparing survival time for both groups show statistically insignificant difference between groups (p value >0.05)) which indicates no

synergistic effect is observed in self ligation MBT group in alignment and leveling phase when combined with periodontally accelerated osteogenic orthodontics with respect to treatment duration compared to conventional MBT group.

TABLE 11 - Pearson correlation between space discrepancy and duration of alignment and leveling (figure 28 and 29)

		Space Discrepancy (mm)	
Duration of leveling and alignment (days)	Correlation	0.767	
	p-Value	0.001	
	N	16	
Group		Space Discrepancy (mm)	
Self ligation	Duration of leveling and alignment (days)	Correlation	0.798
		p-Value	0.018
		N	8
Conventional	Duration of leveling and alignment (days)	Correlation	0.742
		p-Value	0.035
		N	8

Pearson corelation of self ligation group is 0.798 (p value - 0.018) and conventional elastomeric ligation group is 0.742. (P value - 0.035) which indicates treatment duration of alignment and leveling increases with space discrepancy.

TABLE 12 - Paired Samples t-test to compare mean values between pre-treatment (T0) and post treatment (T2) lower incisor inclination values within the groups (figure 22, 23, 24)

Group	Variables	N	Mean	Std. Dev	t-Value	p-Value
	L1-MP: T0 (°)	8	106.25	8.345	3.416	0.011
	L1-MP: T2 (°)	8	105.63	8.684		
Self ligation	L1-A-Pog: T0 (°)	8	33.25	2.550	4.583	0.003
	L1-A-Pog: T2 (°)	8	32.50	2.449		
	L1-NB: T0 (°)	8	36.25	4.062	4.583	0.003
	L1-NB: T2 (°)	8	35.50	3.891		
Conventional	L1-MP: T0 (°)	8	102.38	4.838	3.813	0.007
	L1-MP: T2 (°)	8	101.25	5.312		
	L1-A-Pog: T0 (°)	8	35.63	1.598	7.638	<0.001
	L1-A-Pog: T2 (°)	8	34.38	1.506		
	L1-NB: T0 (°)	8	36.25	4.062	3.742	0.007
	L1-NB: T2 (°)	8	35.25	3.991		

Significant differences exist in lower incisor inclination values between pre - treatment(T0) and post- treatment values (T2)within the self ligation MBT group and conventional MBT group with respect to L1-MP (Mandibular incisor to mandibular plane ,) L1-NB (mandibular incisor to nasion-Point B line,)and L1-A-Pog, (mandibular incisor to Point A-pogonion line) p value <o.o5

TABLE 13 - Descriptive Statistics to compare lower incisor inclination changes between self ligation and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics

		Self ligation	Conventional
Inclination changes in L1-MP (°)	N	8	8
	Mean	-0.625	-1.125
	Std. Dev.	.518	.835
	Median	1.00	1.00
	1st Quartile	.00	.50
	3rd Quartile	1.00	2.00
Inclination changes in L1-A-Pog (°)	N	8	8
	Mean	-0.750	-1.250
	Std. Dev	.463	.463
	Median	1.00	1.00
	1st Quartile	.50	1.00
	3rd Quartile	1.00	1.50
Inclination changes in L1-NB (°)	N	8	8
	Mean	-0.750	-1.000
	Std. Dev	.463	.756
	Median	1.00	1.00
	1st Quartile	.50	.50
	3rd Quartile	1.00	1.50

Lower incisor inclination changes[between pre –treatment (T0) and post-treatment values (T2)] between self ligation MBT bracket group and

conventional elastomeric MBT bracket group with respect to L1-MP (Mandibular incisor to mandibular plane ,self ligation MBT -0.625 degrees and conventional MBT-1.125degrees) L1-NB (mandibular incisor to nasion-Point B line self ligation MBT -0.750degreesand conventional MBT-1.250)and L1-A-Pog, (mandibular incisor to Point A-pogonion line self ligation MBT -0.750degreesand conventional MBT-1.000degrees)

TABLE 14 - Mann – Whitney test to compare lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics

Variables	Group	N	Mean Rank	Z-Value	p-Value
Inclination changes in L1-MP (°)	Self ligation	8	7.06	1.317	0.188
	Conventional	8	9.94		
Inclination changes in L1-A-Pog (°)	Self ligation	8	6.75	1.936	0.053
	Conventional	8	10.25		
Inclination changes in L1-NB (°)	Self ligation	8	7.75	0.732	0.464
	Conventional	8	9.25		

Statistically insignificant differences exist in lower incisor inclination changes [between pre -treatment(T0) and post- treatment values (T2)]between self ligation MBT bracket group and conventional elastomeric MBT bracket group with respect to L1-MP (Mandibular incisor to mandibular plane ,p value0.188) L1-NB (mandibular incisor to nasion-Point B line, p value-0.053)and L1-A-Pog, (mandibular incisor to Point A-pogonion line p value-0.464).

TABLE 15 - Descriptive Statistics to compare root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics

		Self ligation	Conventional
Mean root resorption score	N	8	8
	Mean	.625	.604
	Std. Dev	.509	.510
	Median	.59	.50
	1st Quartile	.25	.25
	3rd Quartile	1.00	1.00
Mean root resorption length per patient (mm)	N	8	8
	Mean	.500	.500
	Std. Dev	.378	.378
	Median	.50	.50
	1st Quartile	.25	.25
	3rd Quartile	.75	.75
Total root resorption length per patient (mm)	N	8	8
	Mean	3.000	3.000
	Std. Dev	2.268	2.268
	Median	3.00	3.00
	1st Quartile	1.50	1.50
	3rd Quartile	4.50	4.50

Mean root resorption score of self ligation MBT 0.625 and conventional MBT-0.604, Mean root resorption length in millimetres of self ligation MBT -

0.500 and conventional MBT-0.500 and Total root resorption length in millimetres self ligation MBT -3.000and conventional MBT-3.000

TABLE 16 - Mann – Whitney test to compare root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics (fig 25, 26, 27)

Variables	Group	N	Mean Rank	Z-Value	p-Value
Mean root resorption score	Self ligation	8	8.75	0.217	0.828
	Conventional	8	8.25		
Mean root resorption length (mm)	Self ligation	8	8.50	0.000	1.000
	Conventional	8	8.50		
Total root resorption length (mm)	Self ligation	8	8.50	0.000	1.000
	Conventional	8	8.50		

Statistically insignificant differences exist in root resorption levels[between pre–treatment (T0) and post- treatment values (T2)] between self ligation MBT bracket group and conventional elastomeric MBT bracket group with respect to Mean root resorption score, (p value-0.828), Mean root resorption length in millimetres (p value-1.000) and Total root resorption length in millimetres (p value-1.000)

TABLE 17 - Multiple Response Analysis to show the tooth more prone to root resorption within the group and between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics

Tooth with root resorption		Self ligation	Conventional	Total
31	N	2	2	4
	%	33.3%	33.3%	
32	N	4	4	8
	%	66.7%	66.7%	
41	N	2	2	4
	%	33.3%	33.3%	
42	N	3	2	5
	%	50.0%	33.3%	
43	N	1	1	2
	%	16.7%	16.7%	
Total		6	6	12

Multiple response analysis showed lower left lateral incisor (self ligation MBT 66.7 percent of cases and conventional MBT-66.7 percent of cases) had more root resorption followed by right lower lateral incisor. (Self ligation MBT 50% of cases and conventional MBT-33.3% of cases). Both lower central incisors showed root resorption in both groups. (Self ligation MBT 33.3% of cases and conventional MBT-33.3% of cases).Left lower canines didn't show any root resorption whereas right lower canines showed resorption in certain cases in both groups. (Self ligation 16.7% of cases and conventional -16.7% of cases). Lower lateral incisors showed more root resorption than lower central incisors.

TABLE 18 - Multiple response analysis to show number of teeth fitting into Indian norms and the teeth which did not fit into Indian norms of normal mesio distal angulations after alignment and leveling

Teeth fitting into Indian norms angulation after treatment		Self ligation	Conventional	Total
31	N	3	2	5
	%	37.5%	25.0%	
32	N	8	8	16
	%	100.0%	100.0%	
33	N	3	2	5
	%	37.5%	25.0%	
41	N	3	2	5
	%	37.5%	25.0%	
42	N	8	8	16
	%	100.0%	100.0%	
43	N	3	2	5
	%	37.5%	25.0%	
Total	N	8	8	16

TABLE 19 - Multiple response analysis to show number of teeth fitting into Indian norms and the teeth which did not fit into Indian norms of normal mesio distal angulations after alignment and leveling

Number of teeth fitting into Indian Norms	Group					
	Self ligation		Conventional		Total	
	N	%	N	%	N	%
0	3	37.5%	2	25.0%	5	31.3%
4	5	62.5%	6	75.0%	11	68.8%
Total	8	100.0%	8	100.0%	16	100.0%

Chi-Square Test	p-Value
Fisher's Exact Test	0.992

Fischer exact chi square test showed 62.5% of self ligation post treatment lower anterior teeth mesio distal angulation fit into Indian norms whereas 37.5% did not fit. 75% of conventional MBT post treatments lower anterior teeth mesio distal angulation fit into Indian norms whereas 25% did not fit.

DISCUSSION

Orthodontic tooth movement is a biological response to mechanically applied orthodontic force. This study is a novel attempt in finding out any synergistic effect with use of self ligation bracket system along with accelerated orthodontics by modifying biological response through Wilckodontics and applying the mechanical force delivery more effectively through self ligation bracket system. Periodontally accelerated osteogenic orthodontics increases the rate of orthodontic tooth movement by regional acceleratory phenomenon that is increased bone turnover and decreased bone density[24, 25, 35]. Baloul *et al* (2011)[88] have shown in their animal study that combined selective alveolar decortication with tooth movement group showed an increase in rate of tooth movement till 21 days with peak at 7days. Conventional tooth movement group showed rapid increase in tooth movement only after 7 days. It showed an initial tooth displacement phase from 7 to 14 days followed by lag phase from 14 to 28 days. There is no difference between conventional tooth movement group and the corticotomy with tooth movement group in 28 to 42 days. Corticotomy with tooth movement group showed a decrease in bone volume and bone mineral content compared to normal values at 7 days whereas it was increased in anabolic phase at levels beyond the normal values. These changes were significantly exaggerated and appeared earlier than conventional tooth movement group. Iino et al (2007)[87] in their animal study found a twofold increase in the rate of tooth movement along with less hyalinised zones in corticotomy combined with tooth movement side than the conventional tooth movement side.

Self ligation brackets are proposed to apply the force delivery system more effectively. Ehsani et al[91] conducted a systematic review that included 19 in vitro studies and arrived at a conclusion that self-ligating brackets produced less friction with small round arch wires in well aligned teeth · It is a known fact that resistance to sliding of teeth at the bracket, wire and ligature unit is a combination of friction produced by the ligation method, by the wire-bracket binding and by wire notching. Also, with less friction produced by passive ligation which requires less force needed to move teeth has led to the idea that self-ligating brackets produce more rapid tooth movement. Moreover elastomeric chains produce 50% force decay in first 24 hours which is not seen in self ligation.[126] This study is an attempt to combine the two philosophies namely, periodontally accelerated osteogenic orthodontics and self ligation and it tried to find out if there is an additive effect on the rate of tooth movement. Searching the orthodontic literature in this particular facet yielded no such studies. Hence this study was compared with certain studies which compared self ligation and conventional bracket systems in the absence of corticotomy and also the results were compared with corticotomy studies where the comparison of bracket systems was not done.

Testing synergism of self ligation bracket system in periodontally accelerated osteogenic orthodontics was conducted in patients with lower arch crowding because crowding correction mainly requires free play of the arch wire inside the bracket slot where the role of passive ligation plays a key role.[36] With the help of selective alveolar decortication teeth aligns by moving through the path of least resistance buccally and lingually. Extraction cases were chosen to remove the biological barrier distally for alignment. Both the groups were matched by choosing 6 girls and 2 males in the age group of 17 to 23 years with

space discrepancy of 7-10 mm with a mean value of 8 mm which is mostly due to lower anterior crowding. Cases with deep curve of spee in the mandibular arch were not included. Wilckodontics was done till the first premolar extraction space to increase the anchorage of posteriors since all the cases were high anchorage cases. The brackets and the arch wire sequence used in this study was similar to the brackets and the arch wires suggested by Lian O'Dywera and Rahman et al[85] in their multicentered randomised control trial based on recommendations of 3M manufacturers for study purpose as quoted in his article. Both the brackets have MBT prescription with 0.022 X 0.028 inches slot and the choice of these brackets were made to eliminate the differences in tip and torque so that free play of the self ligating bracket can be tested efficiently. Arch wire progression was made till the 0.019 inches x 0.025 inches stainless steel wire so that brackets express more tip and torque. Initial aligning wire used in the study was 0.014 inch round niti (nickel titanium) wire in both groups. 0.018inches round wire served the purpose of transitional wire in the conventional elastomeric group to get shifted to a rectangular niti wire when the alignment is not yet completed. The transitional wire used in the self ligation group was 0.016 x 0.022 inches niti, since self ligation bracket has poor torque control in round niti wire[52] for a prolonged time. The arch wire progression was done based on the full passive engagement of the wire. 0.019 inches x 0.025 inches heat activated copper niti is the leveling arch wire used in both the groups. When 0.019 x 0.025 inches stainless steel wire can be engaged passively in the bracket slot, alignment and leveling is assumed to be complete as suggested by Mc Laughlin, Bennett and Trevisi.[115-118] Moreover complete alignment is crosschecked in the cast by checking whether Little's irregularity index value is zero. Lower incisors have short interbracket span so

that insertion of a 0.019 x 0.025 inches stainless steel wire[127] is a clear cut indication that it is well aligned. Banding second molars initially, usage of 0.019 x 0.025 inches HANT and 0.019 x 0.025 inches stainless steel aid in complete leveling as suggested by Mc Laughlin, Bennett and Trevisi [115-118]. First arch wire was secured one week after corticotomy and patients were recalled once in two weeks as suggested by Wilcko et al[125] for Wilckodontics in order to make use of the maximum amount of regional acceleratory phenomenon. Elastomeric ligation was used as control because it gives more friction than stainless steel ligation as stated by Khambay et al[68] and the proposed advantages of the self ligation bracket system that it has less friction and reduced treatment time can be compared and tested with elastomeric ligation with more statistical significance.

Comparison of treatment duration of alignment and leveling of mandibular arch between self ligation MBT bracket group and conventional elastomeric MBT bracket group results have shown that there is no difference in treatment duration of alignment and leveling between both the appliance groups. No synergistic effect is observed in self ligation MBT group when combined with Wilckodontics with respect to treatment duration in alignment and leveling phase compared to conventional MBT group. It took an average time of 106 days in conventional MBT group whereas 104.13 days in self ligation MBT group for alignment and leveling. There was a positive correlation between the amount of crowding and treatment duration as evident in this study. Due to lack of availability of samples many inclusion and exclusion criteria were removed. Shoreibah[52,53] et al observed a total treatment time of 14-20 weeks till debonding in lower anterior crowding cases with corticotomy. These results are almost coinciding with our study. Amount of crowding and irregularity, differences in appliances, wire sequence,

method of force application during retraction, extraction or nonextraction method and operator difference (periodontist and orthodontist) should be considered. The results should be cautiously compared with other studies and evaluated since only alignment and leveling phase is completed. The results can be compared with study reports by Machibya et al [81]who stated that there is no significant differences in treatment duration between self ligating MBT and conventional MBT since the study design is similar to this study that is they have used same bracket systems and followed extraction mechanics but the study was conducted without wilckodontics. Scott et al[72] reported no difference between self ligation brackets and conventional brackets in extraction cases without corticotomy. Difference in study design, time of evaluation and differences in bracket prescription exist between their study and this study. The conclusion of this study that self ligation brackets do not have more alignment efficiency than conventional brackets is consistent with results of study conducted by Pandis et al[36] but there is a difference in study design with respect to materials and methods. The results of this study show that there is no added advantage of self ligation bracket system over conventional elastomeric MBT brackets is consistent with findings of O 'Dywer et al[86] who conducted a multicentered trial with same brackets used in this study. But the results are contradictory to reports by Fleming et al[74] and Wahab et al[79] who stated that conventional MBT brackets are more efficient than self ligation brackets with respect to treatment duration. Wahab et al[79] concluded that even after 4 months alignment period, 98 percent crowding correction in conventional group was observed but only 67 percent crowding alleviation was seen in self ligation group. The results of this study were obtained after alignment and leveling phase in the presence of corticotomy. Thus this is a

new study with which results of other study cannot be compared more directly. Moreover self ligation brackets had no added advantage over conventional elastomeric MBT bracket even in the presence of periodontally accelerated osteogenic orthodontics. Probably this study had finally broken the myth that the self ligation bracket system reduces treatment time.

Comparison of pre (T0) and post treatment (T2) lower incisor inclination within the group in self ligation MBT bracket group (L1-MP is -0.625°, L1-A-Pog is -0.750°, L1-NB is -0.750°) and conventional elastomeric MBT bracket group (L1-MPis -1.125°,°, L1-A-Pog is -1.250°, L1-NB is-1.000°) results have shown statistically significant differences that is both bracket systems reduced inclination of lower incisors .Comparison of mean of differences in pre and post treatment lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group results have shown statistically insignificant differences .Though conventional MBT group have shown more retroclination compared to self ligation MBT group cephalometrically, no significant differences exist between both the groups statistically because of smaller sample size. Results of this study were consistent with findings of Machibya et al[81] who reported more lingual inclination of mandibular incisors in the conventional elastomeric group (3.62 degrees) than in the self ligation group. They have used same brackets and followed extraction philosophy. Our results were contradictory to the results obtained by Scott et al[72] who stated that incisors align by proclination in extraction cases in both groups and no significant difference was obtained between groups. Though the results were taken immediately after alignment and leveling phase like this study the results are not comparable to this study since they used different bracket systems

with different tip and torque (compared Damon and Roth) and they evaluated in the absence of corticotomy. Ferguson and Wilcko [128] et al observed retroclination of upper incisors after completion of treatment by 0.8 degree in corticotomy group but proclination of 1 degree in conventional treatment group without corticotomy. They observed a prognathic position of A point in the cephalogram and they have attributed the reason to alveolar bone grafting. This also could be one of the reasons for reduced inclination values especially for lower incisor to A point-Pogonion. More studies have to be conducted to confirm these findings. .These findings correlate with our study since retroclination of incisors is observed in both conventional MBT and self ligation MBT group in PAOO (Periodontally Accelerated Osteogenic Orthodontics). The reason for retroclination of incisors could be attributed to extraction mechanics, tight cinching back and increased range of tooth movement caused by selective alveolar decortication.

Statistically insignificant differences exist in root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in Wilckodontics in our study. Lower lateral incisors showed more root resorption than lower central incisors in both groups in PAOO in this study**.** Root resorption in canines in both groups was very rare in this study. Reitan[129] proposed that a strong continuous force on low density alveolar bone caused an equivalent amount of root resorption to that of a mild continuous force on high density alveolar bone. Ferguson and Wilcko[128] et al have shown that root resorption existed in both the corticotomy and conventional treatment group but corticotomy group have shown less root resorption.0.3mm root resorption was observed in 6 months treatment duration in corticotomy group. In this study 0.5mm root resorption was observed in a time period of three and a half months.

Shoreibah [52,53]et al have shown root resorption of -0.056 mm +/- 0.025 in corticotomy without grafting group whereas -0.050 mm +/- 0.026 in corticotomy group with grafting group. The differences could be attributed to the method of evaluation and patient related factors like age, sex and genetics.[130] Vanessa Leitea et al[131] compared root resorption between self ligating and conventional bracket in the early phase like our study and found no difference. If root resorption is detected early it is an indication that more root resorption will occur in the feature.[132] But Levander and Malmgren[133] et al have shown that in cases which are more prone to resorption radiographs of 3 months interval could reveal significant changes.

Results have shown that 62.5% of self ligation post treatment lower anterior teeth mesio distal angulation values fit into Indian norms whereas 37.5% did not fit. 75% of conventional MBT post treatment lowers anterior teeth mesio distal angulation fit into Indian norms[123] whereas 25% did not fit .Though conventional MBT achieves greater success in achieving post alignment and leveling mesio distal angulations close to Indian norms than self ligation group, statistically insignificant differences exist between groups because of smaller sample size. Lower lateral incisors were the most common teeth which do not fit into mesio distal angulations of Indian norms. Mesiodistal angulation of teeth is an important aspect of alignment phase of orthodontic treatment. Panoramic radiographs have to be carefully used to interpret mesiodistal angulations because they show error in the results by showing teeth more distally angulated as well as magnification and distortion are more.[134] Because of these reasons only few studies Hatasaka et al[135], Myoral et al[136], Ursi et al[124]have evaluated mesiodistal angulations by panoramic radiographs at the end of treatment. No literature

evidence is available which evaluate mesiodistal angulations immediately after alignment and leveling phase for comparison. Though mesio distal angulation of the teeth used to change after space closure this study continued to evaluate to show how efficiently both the bracket system align the teeth .It also helps us to bring changes in effective tip expressed. This study suggest that lower lateral incisors show more distal angulation with mesial root tipping which could be corrected by incorporating lesser distal tipping values. The finding of this study that lower lateral incisor do not achieve root parallelism is an indication that it is not properly aligned mesiodistally. This is consistent with statement of American board of Orthodontics that most orthodontists lost score in their exams when it comes to the alignment of lower lateral incisors.[137]

SUMMARY AND CONCLUSION

Periodontally accelerated orthodontics is a proven method for reducing the orthodontic treatment duration. Self ligation brackets have shown less friction which is proposed to produce lighter forces in laboratory studies. The main aim of the study was to find any synergism of self ligating MBT brackets in reducing the treatment duration of alignment and leveling of mandibular arch in periodontally accelerated osteogenic orthodontics. Sixteen samples were selected from forty outpatients of Department of Orthodontics (Tamil Nadu Government Dental College and Hospital, Chennai) with Angles class 1 malocclusion who underwent extraction of first premolar for correction of crowding based on inclusion and exclusion criteria. Patients from both genders with age group of 17 to 23 years were selected. The selected samples were divided into two groups by systematic random sampling. 8 subjects in group A were treated with self- ligation MBT bracket system in PAOO and 8 subjects in group B were treated with conventional ligation MBT bracket system in PAOO.Following conclusions were derived from this study,

1. Mean treatment duration for alignment and leveling in the mandibular arch in self ligation MBT group in periodontally accelerated osteogenic orthodontics is 104.13 days.
2. Mean treatment duration for alignment and leveling in the mandibular arch in conventional MBT group in periodontally accelerated osteogenic orthodontics is 106 days.

3. No statistically significant differences were found in the duration of alignment and leveling in mandibular arch in periodontally accelerated osteogenic orthodontics between both groups.
4. No synergistic effect was observed in self ligation MBT group in alignment and leveling phase when combined with periodontally accelerated osteogenic orthodontics with respect to treatment duration compared to conventional MBT group
5. Comparison of pre and post treatment lower incisor inclination within the group in self ligation MBT bracket group and conventional elastomeric MBT bracket group results showed retroclination of incisors in both groups. Comparison of post treatment (T2) lower incisor inclination changes between self ligation MBT bracket group and conventional elastomeric MBT bracket group results had shown statistically insignificant differences.
6. No differences were found in root resorption levels between self ligation MBT bracket group and conventional elastomeric MBT bracket group in periodontally accelerated osteogenic orthodontics. Lower lateral incisors showed more root resorption in both groups**.**
7. 62.5% of post treatment lower anterior teeth mesio distal angulation fit into Indian norms whereas 37.5% did not fit in self ligation MBT group. 75% of post treatment lowers anterior teeth mesio distal angulation fit into Indian norms whereas 25% did not fit in conventional MBT group .No significant differences was found between both groups. Lower lateral incisors were the most common teeth which did not fit into mesio distal angulations of Indian norms.

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ANNEXURE 1

PARTICIPANT INFORMATION SHEET (ENGLISH)

TITLE OF THE STUDY: "Comparison of the effects of self ligating versus conventional Mc Laughlin, Bennett and Trevisi brackets in the correction of lower anterior crowding in periodontally accelerated osteogenic orthodontics-a prospective study"

NAME OF THE RESEARCH INSTITUTION: Tamilnadu Government Dental College and Hospital.

PURPOSE OF THE STUDY: The purpose of the study is to compare duration and dental effects of alignment and leveling in self ligation bracket system and conventional bracket system in periodontally accelerated osteogenic orthodontics.

PROCEDURE OF THE STUDY: The selected patients will be treated with periodontally accelerated osteogenic orthodontics which involves a minor surgical procedure. Then the treatment duration and accompanying dental effects of alignment and leveling in self ligation bracket system and conventional bracket system in periodontally accelerated osteogenic orthodontics will be evaluated.

RISK OF PARTICIPATION: Pain, swelling, ecchymosis (colour change) and ecchymosis are side effects.

BENEFITS OF PARTICIPATION: Side effects of prolonged treatment duration are expected to minimize. Increase alveolar bone support, rapid orthodontic treatment time and time saving for the patient are expected. Patient confidence improves during orthodontic treatment.

ANNEXURE 2

INFORMED CONSENT FORM (ENGLISH)

"**Comparison of the effects of self ligating versus conventional Mc laughlin, Bennett and Trevisi brackets in the correction of lower anterior crowding in periodontally accelerated osteogenic orthodontics-a prospective study**".

Participant ID No:

I have read the foregoing information sheet given to me about the methods and procedures to be followed for the study, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this study and understand that I have the right to withdraw any time without in any way it affecting my further medical care."

Date _____ _____

Name of the participant Signature of the participant

[The literate witness selected by the participant must sign the informed consent form. The witness should not have any relationship with the research team; if the participant doesn't want to disclose his / her participation details to others, in view of respecting the wishes of the participant, he / she can be allowed to waive from the witness procedure (This is applicable to literate participant ONLY). This should be documented by the study staff by getting signature from the prospective participant]

_____

"I have witnessed the accurate reading of the consent form to the potential participant and the individual has had opportunity to ask questions. I confirm that the individual has given consent freely"

Date _____ _____

Name of the witness Signature of the witness

Date _____ _____

Name of the interviewer Signature of the interviewer

ANNEXURE 3

PARTICIPANT INFORMATION SHEET (TAMIL)

தகவல் அறிவிப்பு படிவம்

- நாங்கள் தமிழ்நாடு அரசு பல் மருத்துவமனை மற்றும் கல்லூரியின் நோயாளிகளுள் **"பல் சீரமைப்பிற்காக பற்களின் மேல் பொருத்தப்படும் பல் சீரமைப்பு உலோக பொத்தான் (orthodontic Bracket) மற்றும் தானாக மூடி திறக்கும் உலோக பொத்தானை (Self Ligating Bracket) கொண்டு கோரப்பல்லை பின் தள்ளுதல் மற்றும் கடைவாய்ப்பல்லின் ஊன்றுதல் திட நிலையை ஒப்பிடுதல் பற்றிய ஆய்வு"** மேற்கொண்டுள்ளோம்.

- பல சீரமைப்பு சிகிச்சைக்காக பல் சீரமைப்பு உலோக பொததான் பற்களின் மேல் ஒட்டப்படும். பல் சீரமைப்பு பொத்தான்கள் பல வகைப்படும். அதில் இருவகையான பல் சீரமைப்பு உலோக பொத்தான் மற்றும் தானாக மூடி திறக்கும் உலோக பொத்தானைக் கொண்டு வழக்கமான பல் சீரமைப்பு சிகிச்சை மேற்கொள்ளப்படும்.

- இரு வகையான பல் சீரமைப்பு உலோக பொத்தானைக்கொண்டு இந்த ஆய்வில் கோரைப்பல் மற்றும் கடைவாய்ப்பல் அசைநன் அளவை பல் மாதிரி உருவப்படிவம் கொண்டும், கதிர் வரைபடம் கொண்டும் அளக்கப்படும்.

- இந்த ஆராய்ச்சியில் பங்கேற்கும் நோயாளிகளினி விவரங்கள் ஆய்வு முடியும் வரை இரகசியமாக வைக்கப்படும். ஆராய்ச்சியின் முடிவு பற்றிய பதிப்புகள் அல்லது வெளியீடுகளில் யாருடைய தனிப்பட்ட விவரங்களும் பகிர்ந்துகொள்ளப்படமாட்டாது.

- ஆராய்ச்சியில் பங்கேற்பது நோயாளிகளின் தன்னிச்சையான முடிவாகும் மற்றும் எந்த நேரத்திலும் இந்த ஆய்விலிருந்து சட்ட உரிமைகள் பாதிக்கப்படாமல் விலகிக்கொள்ளலாம்.

- இந்த சிறப்பு ஆய்வின் முடிவு, இந்த ஆய்வின்போதோ அல்லது ஆய்வின் முடிவிலோ தங்களுக்கு தெரிவிக்கப்படும்.

.....	.....	.....
நோயாளியின் பெயர்	கையொப்பம்/பெருவிரல் ரேகை	தேதி
.....	.....	.....
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	தேதி

ANNEXURE 4

INFORMED CONSENT (TAMIL)

ஒப்புதல் படிவம்

ஆராய்ச்சியின் தலைப்பு

"பல் சீரமைப்பிற்காக பற்களின் மேல் பொருத்தப்படும் பல் சீரமைப்பு உலோக பொத்தான் (orthodontic Bracket) மற்றும் தானாக மூடி திறக்கும் உலோக பொத்தானை (Self Ligating Bracket) கொண்டு கோரப்பல்லை பின் தள்ளுதல் மற்றும் கடைவாய்ப்பல்லின் ஊன்றுதல் திட நிலையை ஒப்பிடுதல் பற்றிய ஆய்வு"

பெயர் : புற நோயாளி எண்:

முகவரி : எண் :

தொலைபேசி எண்: வயது/ பால்:

நான் ..... வயது ..... வருடம் என்னுடைய சுய நினைவுடனும் மற்றும் முழு சுதந்திரத்துடனும் **"பல் சீரமைப்பிற்காக பற்களின் மேல் பொருத்தப்படும் பல் சீரமைப்பு உலோக பொத்தான் (orthodontic Bracket) மற்றும் தானாக மூடி திறக்கும் உலோக பொத்தானை (Self Ligating Bracket) கொண்டு கோரப்பல்லை பின் தள்ளுதல் மற்றும் கடைவாய்ப்பல்லின் ஊன்றுதல் திட நிலையை ஒப்பிடுதல் பற்றிய ஆய்வு"**ல் என்னை சேர்த்துக்கொள்ள சம்மதிக்கிறேன்.

நான் கீழ்கண்ட விதிமுறைகளுக்கு சம்மதிக்கிறேன்.

- இந்த ஆராய்ச்சியின் நோக்கம், மருத்துவ முறைகள் மற்றும் பரிசோதனை முறைகள் எனக்கு திருப்தியூட்டும் வகையில் விளக்கப்பட்டன.
- இந்த ஆராய்ச்சியின் செயல்முறைகளில் என்னை உட்படுத்திக்கொள்ள சம்மதிக்கிறேன்.
- இந்த ஆராய்ச்சியின் முடிவு வரை ஒத்துழைக்க சம்மதிக்கிறேன்.
- என்னுடைய மருத்துவ குறிப்பேடுகளை இந்த ஆராய்ச்சியில் பயன்படுத்திக்கொள்ள சம்மதிக்கிறேன். ஆராய்ச்சி மையமும், ஆராய்ச்சியாளரும் என் பெயர், விவரங்களை இரகசியமாக வைப்பதை அறிகிறேன்.

.....	.....	.....
நோயாளியின் பெயர்	கையொப்பம்/பெருவிரல் ரேகை	தேதி
.....	.....	.....
ஆராய்ச்சியாளரின் பெயர்	கையொப்பம்	தேதி